THE GLASS INDUSTRY

VOLUME 25, NUMBER 12, DECEMBER, 1944

THE EIGHTH URBANA GLASS CONFERENCE

Symposium on Glass Melting in Tank Furnaces attracts record attendance. Interest in meeting is heightened by lively and provocative open discussions.

The annual conferences on glass problems, which are held under the auspices of the University of Illinois, Department of Ceramic Engineering and the Chicago Section of the American Ceramic Society, have been resumed after a lapse of two years. The Eighth Conference, which featured a Symposium on Glass Melting in Tank Furnaces, took place November 16 and 17, at the University in Urbana, Illinois. It was originally planned that the meetings be held in the Ceramic Building, but the exceptionally large attendance of over one hundred twenty-five men from the technical and operating departments of glass plants from various parts of the country, necessitated holding the meetings in the large auditorium of the Electrical Engineering Building.

An interesting feature of this conference was that the discussions were in all cases equally important in both character and volume to the papers presented. It was interesting to note that many of the very same men who are quite reluctant to comment on papers dealing with topics of a like nature when such are presented before the Glass Division became quite voluable in this locale.

Since some of the papers which were presented are scheduled for publication in full in THE GLASS INDUSTRY we shall do no more here than attempt to give a general view of the program together with brief summaries of all the papers and a few highlights of the lively discussions.

The first session on Thursday afternoon was opened with two speeches of welcome, the first by Dean M. L. Enger of the College of Engineering and the second by Dr. A. I. Andrews, head of the Department of Ceramic Engineering. Chairman H. H. Blau of Federal Glass Company then took over the serious business of introducing the speakers and "bull-whipping" the attending personnel into the excellent discussions which followed each paper. In the first paper "Batch Mixing and Feeding," W. R. Lester, of Maryland Glass Corporation, aptly discussed the "how, what and why" of modern storage, mixing, conveying and feeding of both the raw materials and the batch. It was indicated that he had been highly successful in tracing down batch mixing faults and raw material contaminations to the work of gremlins and photographic evidence was introduced to

prove this theory. An article describing the mischievous work of these fabulous glasshouse creatures appeared in the March, 1943, issue of THE GLASS INDUSTRY.

In the discussion that followed, R. S. Arrandale of Thatcher Manufacturing Company, gave an interesting black-board talk on how to improvise a new and improved batch plant in and on the site of an old plant without the use of a fourth dimension. The concentric-ring storage bin idea was shown to have interesting possibilities as a batch-mixer eliminator. Some of the group, however, indicated that they would rather have someone else try this idea first.

F. G. Schwalbe of the Toledo Engineering Company, in his paper "Improvements in Tank Furnace Design," gave an excellent and comprehensive review of tank design, port design, firing methods, heat transfer and draft control. (Incidentally, some of the audience are still wondering what happens to all those extra btu's). The subject of tank design provoked quite a controversial and lengthy discussion involving port design, location of the largest port and the location of the so-called "hot spot." In fact, one of the glass furnace men present will be known forever more as "The Man Called X" (with apologies to Mr. Herbert Marshall of wireless and cinema fame).

In the succeeding paper, presented by Mr. Arrandale of Thatcher in a pinch-hitting spot, the subject of furnace operation and control was very ably discussed. His slides showing plan-views of various working furnaces, particularly the one with the mis-placed throat, were very interesting. His presentation of operating data which included the corresponding ring-section grades (A and B) may be the cause of a mass migration of glass container technologists to his office in an effort to find out how he gets them and keeps them that way.

The Friday morning session, with C. A. Bradley of Corning Glass Works presiding, was opened by H. H. Holscher of Owens-Illinois who discussed "Vertical Temperature Gradients in Glasses of Various Colors," a subject which implied that the deeper you go the colder it gets unless you make cobalt-blue glass. With iron in the glass (in the "ons" condition) the bottom glass gets so cold that it becomes necessary to hire a physist to determine your liquidous temperature. Much of the discussion centered around the subject of how hot is the surface glass and the effect of these temperature gradients on fuel consumption and rate of melting.

The penetration of heat from the top surface of the glass down to the deeper sections, especially in tank melting, is known to be influenced by the color of the glass. With certain colors, notably those containing ferrous iron, the temperature gradient is very steep. The existence of this temperature gradient is responsible for difficulties such as devitrification, stones, frozen throats and low furnace pulls.

The magnitude of this temperature gradient and the effect of different glass colors on the temperature gradient has been investigated by both laboratory and plant studies. In the laboratory study the experimental procedure consisted of, in brief, melting decolorized, undecolorized and various colored glasses in a small gas fired furnace of about 400 lbs. capacity and a furnace depth of approximately 12 inches. By the means of a thermocouple of special design the temperature of the glass at various depths was measured while the surface of the glass was held at 2615 deg. F. Temperature gradients in several commercial tanks melting flint and colored glasses were taken by the use of an 11 foot long water-cooled thermocouple assembly which was inserted into the glass down through the crown of the furnace.

From the results of these studies it was concluded that: 1—In iron containing glasses the temperature gradient is about three times greater where the iron is in the reduced state instead of the ferric state. 2—Chromium oxide glasses (up to 0.25 per cent Cr_2O_3) have about the same gradient as equivalent percentages of ferrous oxide. 3—Manganese does not increase the gradient as much as other oxides giving similar visible color intensities. 4—A small amount of cobalt yields a sky-blue color but decreases the temperature gradient (when compared to the temperature gradient of flint glass). Similar results were found with a selenium pink glass. 5—Decolorization of flint glass increases the gradient in the first inch of the glass surface with little effect at lower depth. 6—Colors can be near matches (cerium topaz and ferric yellow) although the glasses have radically different gradients. The visible color is no guide to the temperature gradient. 7—A crude relationship was found to exist between the gradient and the amount of gas consumed to maintain a 2615 deg. F. surface temperature; the higher the gradient, the lower the amount of gas required; under similar gas consumption the higher the gradient the higher the surface temperature. 8—There was found that there was a direct relationship between the gradients as found by the laboratory procedure and those found in the commercial furnaces.

William Horak of Hartford-Emipre Company, in dealing with "Post Mortem Observations in Tank Furnaces" showed by the use of actual examples how post mortem studies can prove that the petrographer and technologist really knew what they were talking about when they diagnosed the trouble in the first instance. A case of "the proof of the pudding is in the eating." Horak recommends freezing the glass in the furnace when it is shut down and after it is cold, to go in and quarry out sufficient samples from various locations (there being safety in numbers). Chemical, stoichiometrical, petrographical and personal observation procedures are then used in an effort to determine why "such and such" a defect occurred.

The problem of decolorizing tank glass was shown by Axel C. Ottoson of Imperial Glass Company, to be a simple case of good housekeeping or mechanical decolorizing as he called it. Keep the iron out and the decolorizing problem is diminished. Pure raw materials, oxidation, proper balance of decolorizing reagents and the proper nose temperature and atmosphere came in for emphasis. Some attention was given to the theory of color by selective absorption and to the use of proper lighting for the judging of color. The use and non-use of arsenic was fully discussed by several glass men and, in particular, by R. R. Shively of B. F. Drakenfeld and Company. It seemed to be the general opinion that arsenic would not regain its former position as a "must" ingredient as far as decolorization is concerned.

At the close of the session, the attending glass men gave the three B's, Blau, Bradley and Badger a vote of thanks and appreciaton for a well planned and well officiated meeting.

BATCH MIXING AND FEEDING

By W. R. LESTER
Maryland Glass Corporation

The past two or three decades have seen many changes take place in the batch house. Not so many years ago most batch houses consisted of a few wooden bins, a scale, a wheel-barrow and several shovels. The batch was mixed by hand, transferred to the furnace by the means of a batch cart and pushed or shoveled into the doghouse as it was needed. Such a set-up was considered quite satisfactory for the needs of the time. The adoption of mass production methods of melting and forming with their demands for both quantity and quality necessitated corresponding changes in the batching procedure. The quantity requirement was rather easily met through the use of mechanical handling equipment, some of which was adapted from successful systems in use in other industries, while other equipment was specially engineered for the job.

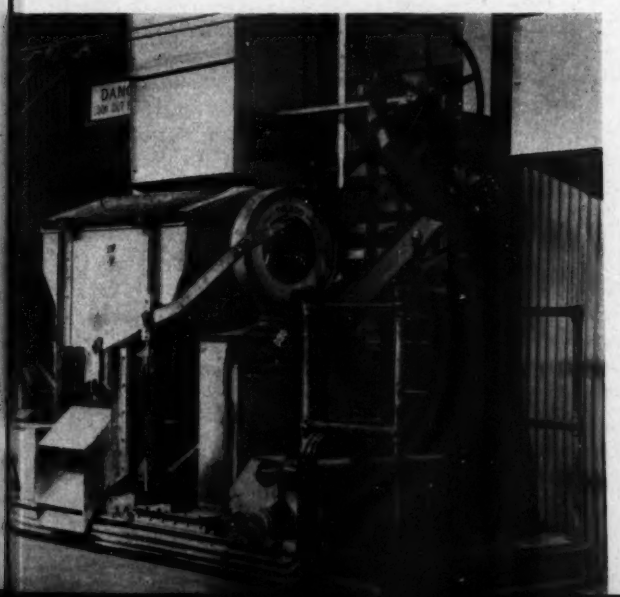
The answer to the quality requirement has not been so simple, for in the easy answer to the quantity requirement old problems such as contamination, segregation and others became magnified. The accent therefore has been upon the elimination of those factors in the batching process that adversely influence the quality of the finished product. What is the "how, what and why" of this phase of the problem?

Storage

A knowledge of the requirements for the proper storage of the raw materials has been gained primarily through experience (sometimes painful). For example, it is common knowledge that soda ash likes to take up water and that hydrated lime and saltcake tend to lump on storage. It is equally well known that some materials flow freely, some too freely, while others flow with great difficulty.

The raw material storage units of today, regardless of whether they have been constructed from hollow tile, concrete, wood or steel, are designed so that they take care of factors such as the proper angle of repose, correct baffling, and the prevention of moisture and sweating. Improvements are still being made. For example, it has been suggested that the storage unit for each individual material be partitioned so as to facilitate rotation and insure that yesterday's shipment is not used before last month's shipment. In the case of natural raw materials which are known to vary in chemical composition or materials which change in composition during storage, this suggestion is Utopia where one is attempting to control the composition or quality of the finished product by the means of routine batch corrections.

Fig. 1



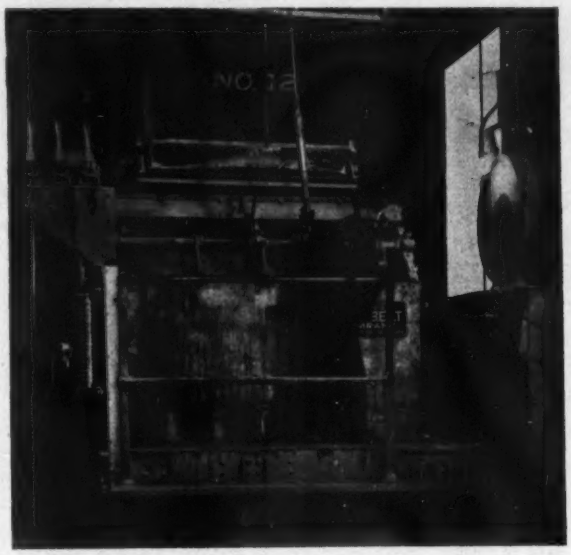


Fig. 2

While proper engineering has taken care of much of the storage problem, the personal equation still remains. Fairly frequently do we hear the story of how someone put the soda ash in the lime bin or the feldspar in the sand bin. Mechanical aids can improve this situation but can never cure it. The same is true of proper supervision, training and laboratory checks. The latter, if done systematically, will give an indication of if, when and how often such a situation exists.

It should be mentioned that, for some materials, the "contamination during storage" problem has been solved by the raw material manufacturer. Examples are the commercial development of dehydrated borax and grades of saltcake which are free from lumping characteristics.

Weighing, Collecting, and Mixing

Three methods have been developed to handle this phase of batching, the manual, the semi-automatic, and the fully-automatic. The manually operated methods generally involve the use of a collecting can (sometimes the mixer itself is used) into which the material is collected either before or after weighing. The collecting

car is then run to the mixer and its contents dumped. If the mixer has been used as the collecting car, mixing takes place as usual. (Figs. 1 and 2.)

Both the semi-automatic and fully-automatic methods utilize a belt conveyor in a dust proof housing, instead of a collecting car, for collecting the raw materials. The collector belt usually delivers to an elevator which, in turn, discharges into a surge bin from which the batch is finally dumped into the mixer. A weight hopper is usually placed under each bin and is connected to a scale. In the semi-automatic method the weight hoppers are filled and emptied manually, while in the fully-automatic method electrically operated feeders fill and empty the weight hoppers. (Fig. 3)

Regardless of whether the weighing, collecting and mixing operations are carried out by manual, semi-automatic or fully-automatic methods, their success depends upon the proper use of two pieces of equipment—the scale and the mixer.

Most scales which are used in the batch house have an accuracy of about 1 part in 500 or better, but as L. G. Ghering has recently shown,* through the use of the quality control chart technique using density range, the bulk of the assignable causes, which in turn were responsible for large density variations and cordy glass, were found to be due to batch weighing errors. These errors may be due to two causes; errors due to the operator (this is particularly true in the case of the manual or semi-automatic method) or to errors due to the scales.

The errors due to the operator may be decreased but not entirely eliminated by the use of scales which record and print the weight and through the proper supervision and training of the operator. Some plants have found that the posting of cord grade and seed count data in the batch room has been helpful in making the operator realize the importance of his job and its relation to the other phases of the manufacturing process. The complete cure, of course, is the use of fully automatic methods.

Fig. 3

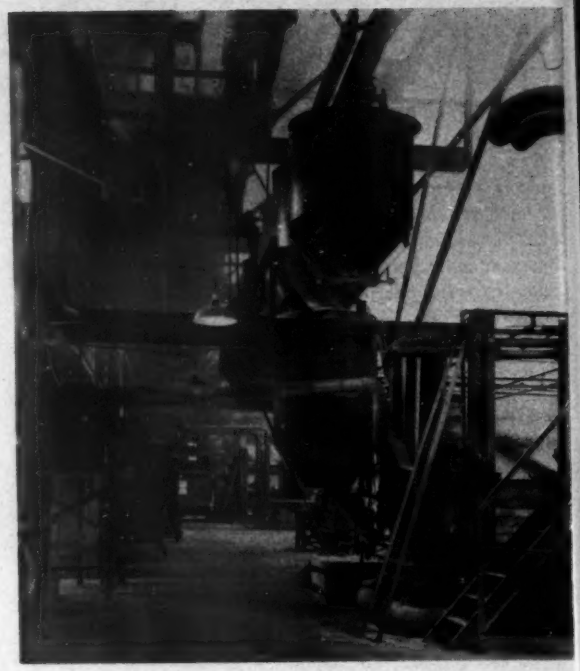


Fig. 4

Scale errors are due to the scale being out of adjustment and may be eliminated by the frequent and periodic checking of the scales with standard weights or by check weighings.

The batch mixing machines of today, equipped as they are with suitable baffles, blades, and dust proof devices, are well engineered pieces of equipment and it is difficult to misuse them. However, loading the machine beyond its normal capacity, the use of too low a speed and insufficient time of mixing adversely influence the quality of the mix.

Apart from machine development, much work still needs to be done in the field of mixing. Factors such as grain size, density of the materials, effect of moisture, speed of rotation and others need to be more fully investigated. The most recent work on this subject is due to Brownell and Scholes (*Jour. Amer. Ceramic Society*, 1942, 25, 56-59). Using a small model technique these investigators studied some of these factors and concluded that: 1—grain size and density were important factors, a particle size of less than 20 mesh being desirable, 2—the presence of one material in a fine condition promotes good mixing, 3—balling of certain materials could be minimized if mixed first with the sand alone, 4—addition of water was detrimental, but if used it should be added to the sand alone and before adding the other materials, 5—mixing speed is important, and 6—mixing time is very important—a very short time is usually sufficient as longer times do not improve the homogeneity of the batch. These investigators also state that there is no reason to suppose that segregation can be produced by prolonging the mixing operation.

Conveying

When mechanical handling equipment first came into

* Fall Meeting, Glass Division American Ceramic Soc., Sept. 1944.

use in the batch house the systems that were being used in other industries were adopted. In general, these were the belt conveyor, the screw conveyor and the bucket conveyor. In all three systems it is usual to dump the mixed batch from the mixer onto the conveyor which transports it to the furnace storage silo or bin. While such systems were excellent for handling materials such as coal, grain, and the like, it was found that in the case of glass batch they possessed certain disadvantages. The many motions and movements of these conveying systems give rise to batch segregation troubles. Much study has been given to the subject of segregation with the result that through the use of raw materials of matching grain size, the elimination of all unnecessary motions and movements, and the use of properly designed storage silos or bins, the problem has in many cases been minimized but not entirely eliminated. For example, Table I gives the results of batch analysis made on doghouse samples and taken over a 24-hour period from a conveying system which utilizes an electric truck-bucket elevator batch conveying combination. An analysis of these results indicates that while perfection has not been achieved, it is much better than if the above factors had not been taken into consideration. Incidentally, in this particular conveying system samples of batch taken at various points before reaching the doghouse indicated that while demixing took place along the line, remixing also took place before the batch entered the doghouse.

Fig. 5

TABLE I

	Per Cent		*Per Cent Composition of Batch*		
Time.	*Cullet*	*Batch*	*Insoluble*	*Lime*	*Soda*
12 Noon	20.6	79.4	71.0	11.3	17.7
3 P.M.	16.4	83.6	72.0	8.0	20.0
6 P.M.	15.0	85.0	73.0	10.0	17.0
9 P.M.	12.6	87.4	70.0	10.0	20.0
12 Midnight	6.8	93.2	71.7	10.3	18.0
2 A.M.	10.0	90.0	70.0	10.0	20.0
5 A.M.	9.8	90.0	68.0	8.0	24.0
8 A.M.	14.6	85.4	70.0	9.0	21.0
11 A.M.	17.4	82.6	66.0	15.0	19.0
Theory	15.5	84.5	70.8	9.5	19.7

In an effort to entirely eliminate the segregation of glass batch when it is transferred from the mixer to the doghouse the unit system has been developed. In this method the batch mixer discharges its load into a unit container which is so designed that it holds one complete mixer load. The unit container is then transported to the furnace by tramrail or trucking procedures. By this method the batch remains quiescent and segregation is thereby reduced. (Fig. 4.)

Fig. 6

Batch Feeding

While many glass furnaces are still manually charged (intelligent hand feeding is still one of the most effective methods of distributing the batch across the melting chamber so that all of the available melting area is utilized), many mechanical devices have been proposed and are in use. Most of these work on the pusher-bar or the Archimedes screw principle and are excellent devices for maintaining a constant rate of feed, which in turn insures a constant glass level in the furnace, thus overcoming one of the main disadvantages of manual feeding. (Figs. 5 and 6.)

Modifications of these basic methods have been recently developed; in one, two measuring feeders deliver the batch through a triangular doghouse and automatically distribute islands or strips of batch in the melting area according to a predetermined pattern. In another method, the entire back wall is utilized as a charging bay and the batch is introduced as a shallow blanket which covers the entire furnace width. In both cases the systems are so designed that the batch is presintered before entering the furnace proper. This presintering or

(*Continued on page* 566)

Fig. 7

NEW GLASS RESISTS HF

A new glass resistant to hydrofluoric acid, developed by the American Optical Company, Southbridge, Mass., and just announced by Dr. E. D. Tillyer, research director, should prove distinctly interesting to the glass manufacturing industry. All glass men are fully aware that many industrial processes are dependent on the fundamental attack of HF upon glass. Graduations on scientific glassware, production of reticules, frosting of light bulbs and windows, decoration and also polishing of table and art glassware, marking, and chemical analysis are representative of the many applications utilizing fluoride action. As glass has increasingly become a material of construction for chemical process industries, the parenthesis—"resistant to all acids except HF"—has had to be added in describing the new uses for glass.

The chemical industry stimulated the new glass development. Fluoride catalysts have been increasingly used for many processes, and the wartime demands for aviation gasoline and synthetic rubber have accelerated the trend. Metallic fluoride salts have also been finding many new and expanding uses.

Recognizing the importance of being able to see what was going on in reaction vessels, leaders in fluorine chemistry asked the American Optical Company to apply its extensive experience in phosphate glasses toward evolving a formula for a glass resistant to anhydrous hydrogen fluoride as well as to the various strengths of hydrofluoric acid.

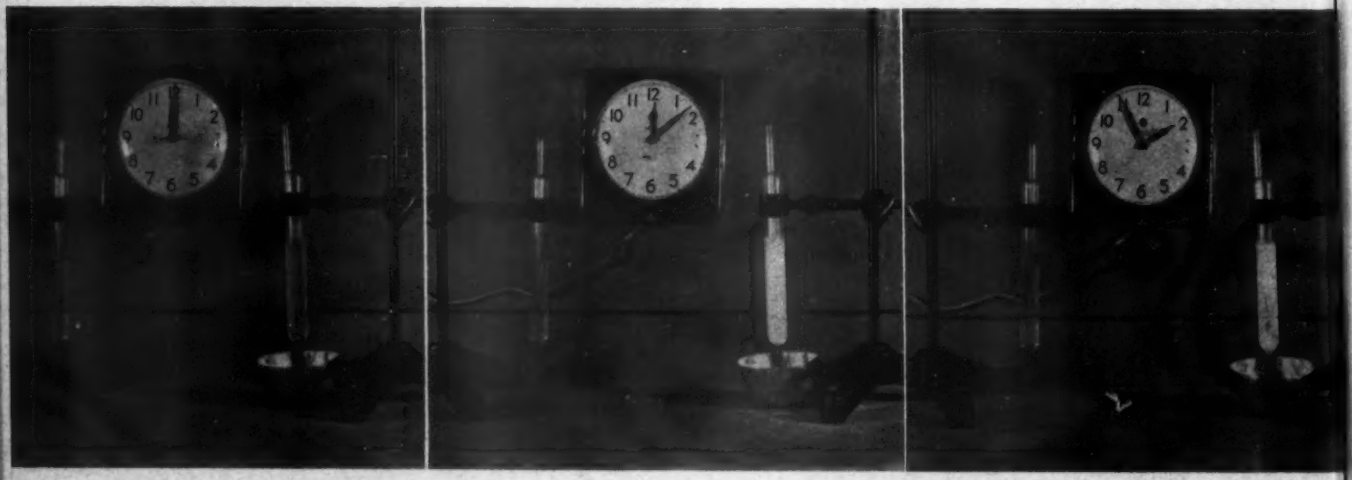
It was known that phosphate glasses were more resistant to HF than silicate glasses, but further properties were demanded. In addition to much greater resistance to fluorides than previous phosphate glasses, low thermal expansion, toughness, ability to make seals and flame working were also needed. From the glass manufacturer's viewpoint it was also essential that the batch melt at reasonable temperatures, fine readily, avoid devitrification, be subject to blowing, drawing, casting, grinding and polishing without the need for drastic modifications of present processes.

The glass, developed by Dr. Alexis G. Pincus of American Optical Company's research laboratories, meets these requirements to a highly satisfactory degree. It can be melted at about 2500 degrees, blown or drawn from about 2000 degrees, and annealed around 1100 degrees F. The quality and color are good. From the pictures it can be seen that the glass has already been blown into a variety of sizes of flasks, beakers, and tubing, and also has been cast into plates which have been ground and polished. Other potential uses are bottles, window panes for laboratories and factories where acids are used, glass gauges, etc. There is a critical temperature region in working where devitrification is apt to occur, but this is not inherent and with further experience it should be overcome. Already it has been found that in flame-working where devitrification has occurred, it can be cured by applying P_2O_5 to the greyed part.

Although the thermal expansion coefficient is about $.5 \times 10^{-6}$ the new glass is tough and withstands considerable thermal shock. One characteristic of the glass, which should extend its field of usefulness, is that even if it is attacked it stays transparent. This should lead to its general adoption in windows for fume hoods and in laboratories and factories where ordinary glass loses transparency.

Glass chemists will probably welcome being able to see the quantity of hydrofluoric acid in their graduates, but they must be wondering: "How are they going to etch the graduations on such laboratory glassware?"

The test tube at the left is made of the new glass while the one at the right is formed from ordinary glass. Major ingredient of the latter glass is sand. At 12 o'clock, as shown by the clock, hydrofluoric acid was poured into both tubes. Instantaneously the acid attacked the tube made of ordinary glass. Stirring rods in both tubes are fabricated from the new glass. In a few minutes the acid has definitely attacked and corroded the tube made of ordinary glass while the tube at the left, made of the new acid-resisting glass, is still transparent. In less than two hours the acid has eaten through the tube made of ordinary glass and has spurted through the hole into the platinum dish and onto the floor. Note that the tube made of the new glass has resisted the attack of the acid and remains transparent.



Carl Silverberg, chemist, sprays hydrofluoric acid fumes against the lenses of a protective hood designed to safeguard workers against acid splashes, dust, etc. Lens at the left, made of ordinary glass, is instantaneously attacked by the deadly gas and made non-transparent. Lens at the right, made out of the new glass, resists the gas and remains perfectly transparent.

Dr. Alexis G. Pincus points to the lens that has been attacked by the acid fumes and is opaque. Lens made of the new glass is still transparent and can be seen through, as shown by the face behind the lens.

Dr. Pincus has dropped into a glass of water a small quantity of phosphorus pentoxide, major ingredient of the new glass. This chemical, which replaces sand used in making ordinary glass, reacts instantaneously with water with almost explosive violence as the picture shows. Despite the remarkable affinity of phosphorus pentoxide for water, the new glass itself is less soluble in water than ordinary glass, indicating the profound chemical change that takes place when the glass is manufactured.

Mr. Silverberg heats a piece of the new glass preparatory to forming a test tube. Laboratory glassware made of the glass is shown on the table at the left.

IMPROVEMENTS IN TANK FURNACE DESIGN

By F. G. SCHWALBE

Toledo Engineering Co., Inc.

Whether or not a glass melting furnace improvement will have any value depends upon the manner in which the furnace is operated. Fig. 1 shows the interior view of a well operated furnace. This furnace which is of the floater type represents good proportions but little new in design features. The operation of this furnace was carefully checked at all times. This careful operation has resulted in extended life, fuel economy and good quality glass. After operation for 1340 days, it was shut down for war reasons only. The excellent condition of the cap, breast walls and back wall is clearly shown. Fig. 2, shows the condition of the first two ports. The right hand port is adjacent to the furnace back wall.

Fig. 3 shows the condition of the checkers under the first port as observed through the regenerator end wall. At no time during the campaign, were checkers blown or reset. The good performance of this furnace can be attributed to the use of briquetted batch and a well designed block cooling system. The cooling system on this furnace is unique in that all of the air is chilled and washed with 50° F water. The water for this purpose is pumped from a sand mine located adjacent to and below the furnace. The operating efficiency of this furnace is shown in Fig. 4.

Let us consider the case of another furnace of good design which was never able to produce quality sheet glass. The difficulty in this case resulted from the use of raw materials of varying composition. The furnace erection engineer inherited as his job the making of quality glass. In this case, persuading the client that the poor quality was not due to furnace design was more difficult than stepping out of the role of furnace designer and solving the customers raw material problem. This was indeed, a problem because no control was had over the source of supply of raw materials. Our engineer friend solved the problem in a unique manner. The first step was the design of a mixer to take the daily 24-hour requirements of batch materials. In this case, 50 tons were required. A batch was compounded and mixed for a period of 8 hours. At the end of 8 hours, samples of the batch were taken from the mixer. An analysis was run on these samples and the required additional raw materials were then added to the mixer to arrive at the desired batch composition. After further mixing, the batch was ready for use. Using this batch in the furnace resulted in good glass quality and the customer then acknowledged that the furnace design was satisfactory.

Combustion

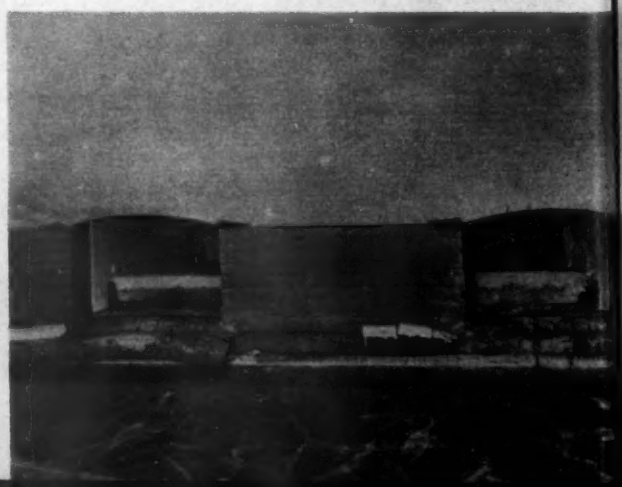
With properly mixed and proportioned batch materials and properly fed to a furnace, we expect to get good glass. To obtain a properly proportioned batch, we analyze and carefully weigh all batch materials and see that the mixed batch reaches the furnace free from segregation.

Let us now see how carefully we have designed to maintain proper combustion within a furnace. Let us consider the design of the furnace combustion air system. Introducing the combustion air to the furnace by natural draft affords no means of knowing the exact amount of air entering the furnace. Such operation is also limited to low output furnaces. Today, furnace designers deliver the combustion air to the furnace by means of a fan. However, will this fan deliver a constant supply of air when no provision is made to correct for seasonal and hourly temperature, relative humidity and barometric pressure changes?

Barometric pressure changes will effect furnace operation. A glass man once advised that whenever there was a violent barometric change, he noticed its effect on the glass in his day tanks, pot furnaces and continuous tank. A second operator advised that when he built a furnace which was to operate at considerable elevation above sea level, he had to increase the size of the furnace over that required at sea level. His approach to just how much bigger the furnace must be made was unique. The average engineer would increase the size of all portions of the furnace inversely as the average barometer at the

Fig. 1

Fig. 2



higher elevation as compared to that at sea level. Combustion-wise, this procedure is correct but we have not taken into consideration the possible effect of barometric pressure on furnace output. Our friend's approach to the problem was as follows: Observation of a day tank indicated that it took approximately 16% more time to plain up the glass at the higher elevation than was required at sea level; accordingly, he increased the melting area of the new furnace 16% over that normally required and the resulting furnace area gave fair results. Strangely enough, the increase in plaining time of 16% was equal to the reduction in barometric pressure between sea level and the average at the higher elevation.

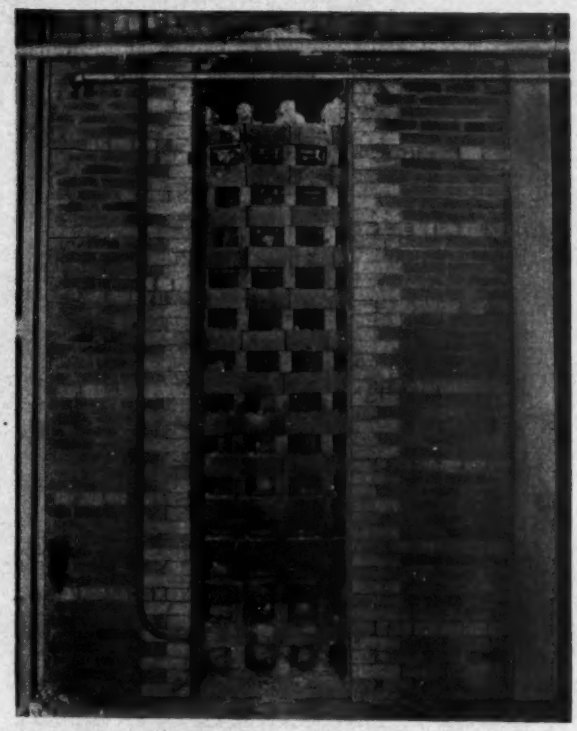


Fig. 3

Ordinarily, the combustion air delivered to a furnace is not seriously affected by small changes in barometric pressure. The widest variation is the result of changes in the temperature of the air. Some means should be provided to adjust the volume of the air supplied to a furnace by correcting it for temperature changes. This can be accomplished by taking the air supply from below the furnace where the temperatures are fairly high and constant. Night and day, and seasonal changes are adjusted by blending colder air into the furnace combustion air fan inlet, thereby maintaining a uniform air temperature.

Operators of blast furnaces control the combustion air supply by means of weight control. To do this requires that the combustion air be delivered at 8 to 10 inches static pressure. This pressure is far in excess of that required for glass furnace operation. The average 130-ton bottle tank normally using a 1½ inch static pressure fan for combustion air requires approximately 3½ horsepower. To deliver the same weight of air at 8 to 10 inches static pressure would require 22.5 horsepower. The difference in horsepower is considerable and therefore weight control has not been adopted by the glass industry. The steel industry has carried combustion air control one step further by adopting various means to control the humidity of both the air and fuel gas. This control has increased blast furnace output, lowered fuel costs and improved the product. Why will it not do the same for the glass industry?

950-B.T.U. GAS PER TON	MONTHS OF FURNACE LIFE	FUEL INCREASE %
13620 Cu.Ft.	1	0
16040 " "	13	15
17860 " "	25	31
20340 " "	40	49

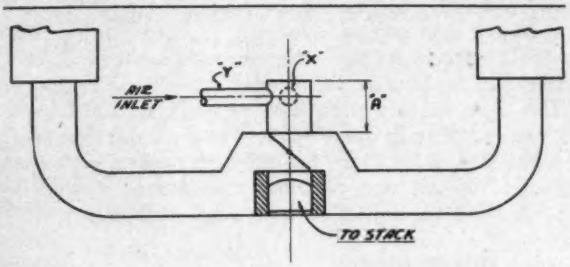


Fig. 4

Furnace Layout

Assuming that we have provided means to control air humidity and temperature, the next important step is to see that the air is properly distributed. A reversing valve that is leaky, with varying amounts on each reversal, will cause no end of difficulty. Air should enter a reversing valve in such a manner that the frictional resistance is the same on both reversals of the valve. Let us take a typical installation as in Fig. 4. Obviously, unless dimension "A" is considerable, the air will have less resistance in passing to regenerator "D" than it will have in passing to regenerator "C." If the air were introduced at "X," the operation would be improved. Assuming that air was introduced at "Y" and dimension "A" was small, let us see how this condition will cause the air to distribute itself in the regenerators and ports of the furnace. It is obvious that when air is going to regenerator "D," its velocity will not be impeded and the last port on the

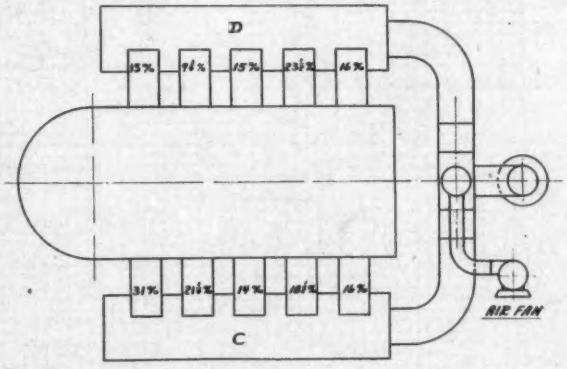


Fig. 5

regenerator will receive more air than the opposite port on the "C" regenerator. Waste gas analysis taken from the ports of such a furnace indicated a distribution somewhat as shown in Fig. 5.

By the use of full opening slide damper type reversing valves, much frictional resistance can be overcome and the air inlets arranged to give balanced operation. This discussion naturally leads us to consider what other means can be resorted to, to definitely control the air supply to each port on a furnace. Furnaces having individual regenerators for each port are in use today. Their construction is more costly than conventional furnaces. The draft on each port must be easily controllable or cross circuiting can take place. Automatically controlled mechanical draft stacks are successfully being used on furnace of this type to deliver the desired amount of combustion air and effect the desired stack draft.

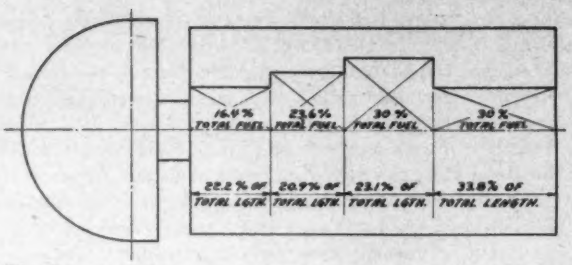

16.9 % TOTAL FUEL
23.6% TOTAL FUEL
30 % TOTAL FUEL
30 % TOTAL FUEL
22.2 % OF TOTAL LGTH.
20.7% OF TOTAL LGTH.
23.1% OF TOTAL LGTH.
33.8% OF TOTAL LENGTH.

Fig. 6

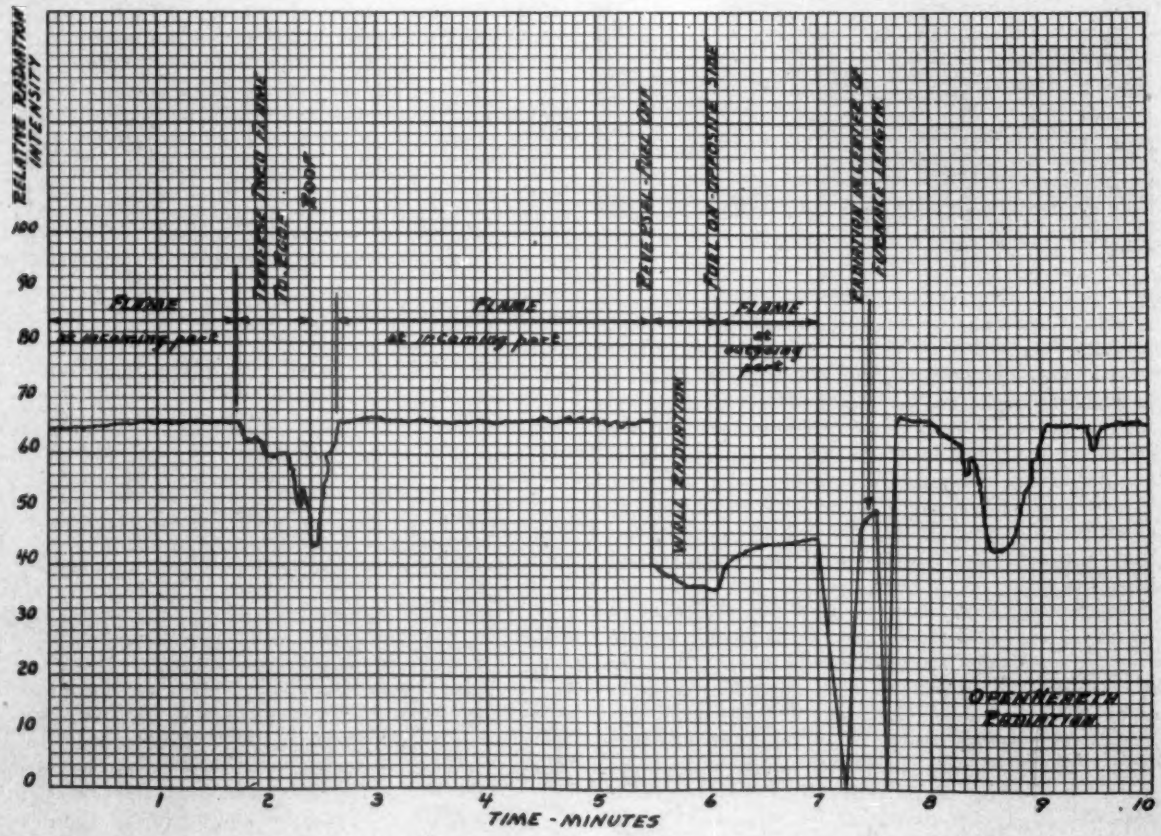
Heat Distribution

When a furnace has a definite heat input established for each port, the conventional types of furnaces can be made to give good results, providing checker chambers can be kept reasonably clean. Great advances have been made towards correcting this difficulty; much is yet to be done. Assuming that we are designing a conventional bottle glass melting furnace, we will find a heat input required approximately as shown in Fig. 6. This heat input leads us to believe that we should provide ports with area in proportion to the heat input required. Such a procedure is the correct engineering approach, and furnaces built in such a manner are giving excellent performance. Some engineers, however, have taken the stand that ports of like size, while not ideal, give satisfactory performance and reduce the stock inventory to the fewest number of individual parts. This view point is open to criticism.

Construction

When competition was keen and special materials could be readily obtained, the tendency was more and more to the use of special shapes. This trend was based on the supposition that such materials could be installed with a minimum amount of labor. With the difficulty of obtaining special materials, we find a return to the use of standard stock materials. Stock materials, with the aid of portable refractory grinding discs and cutting saws, are being installed at reasonable cost and give satisfactory performance. There are, however, still many portions of a furnace where the use of special shapes are unavoidable.

Fig. 7



Radiation

As shown in Fig. 6, it is logical to expect that combustion conditions in a furnace cannot be uniform when a large variation in air supply exists from port to port. The glass industry is also conscious of the value of a flame of high emissivity for use in melting glass. Good combustion control and furnace design is essential to maintain such a flame. Just what the best possible type of flame would be for glass melting has always depended upon the judgment of the furnace operator. Visual observation of a flame can be very misleading. There is now available a recording instrument which measures the intensity of radiation. This device has shown some interesting things when exploring the intensity of radiation within an open hearth furnace. Fig. 7 shows the results of the traverse of such an instrument on the furnace roof and down through the flame to the hearth.

Just what are the best flame characteristics for making glass? What is the best heat distribution based on flame radiation? The possibilities for research with such an instrument in the glass industry are intriguing. The results might well be far reaching on the future design of a glass melting furnace.

Our Russian Allies have been conscious of the value of flame radiation for making glass. Where fuels are used which are low in hydrocarbons, the Russians have resorted to the use of clean by-product tars to enhance the radiation properties of their flames.

In order to operate furnaces at high output rates, it is always necessary to increase the fuel input and adjust the furnace fires so that the fuel will be completely consumed within the confines of the furnace hearth. To accomplish this affects the radiating properties of a flame. Our new type radiation intensity instrument may tell us that we are doing the wrong thing. We may be doing the wrong thing but nevertheless, the glass man will still insist on more and more glass from furnaces without increasing their size. This urge for greater tonnage usually results in lower operating costs, providing that reasonable furnace life can be obtained. A furnace to meet such operating conditions must obviously be redesigned and the first consideration is one of furnace width. When the width of a furnace is increased the length obviously must be decreased to maintain a given area. Greater widths make it possible to develop flames within a furnace which will have greater emissivity and yet complete the combustion within the confines of the furnace hearth. Furnaces designed with increased width have shown themselves capable of producing high tonnage of good glass with exceptionally long furnace life. The average 18 foot furnace should be increased from 2 to 3 feet in width.

Combustion Chamber

With the demand for increased output we must also give consideration to the combustion chamber volume. The present practice is to increase combustion chamber volumes. It is interesting to note that the heat release in a direct fired day tank is approximately 16 Btu per second per cubic foot of combustion chamber. On direct fired continuous tanks it is approximately 9.5 Btu per second per cubic foot of combustion chamber. On the average regenerative furnace melting on a low tonnage basis, the heat release is approximately 3.5 Btu per second. When this same furnace is operated on a high rate of pull the heat release goes up to 4 and 5 Btu per second.

It is interesting to note that the emissivity of the flame is lowest in the case of both the day tank and direct fired continuous tank. Both of these furnaces use premix type burners. The flame of greatest emissivity is usually found in furnaces operating at low rates of pull. Larger combustion chambers will permit operation on lower furnace pressures, providing that other portions of the furnace are properly proportioned.

Regenerators

One of the greatest contributors to excessive furnace pressure is undersize checker chambers with insufficient

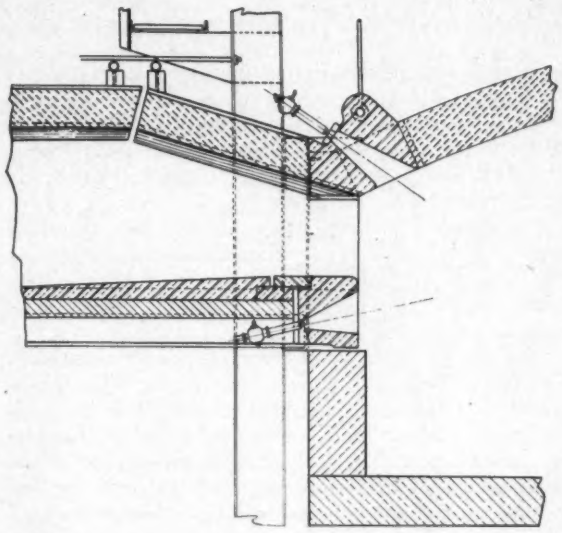


Fig. 8

cross sectional free area. The present tendency is to decrease the waste gas velocity in the checker chambers and provide passages in the checker setting that will reduce the tendency to clog. Average velocities of 6½ feet per second of the waste gases through the checker chambers are not uncommon. These should be reduced to 3½ to 4 feet per second.

Patented checker settings are showing some rather interesting results in special applications. Standard checker settings are still most widely used. The use of special refractories in the port uptakes, regenerator crowns and top course of the checker setting are showing promise of reducing checker slagging and increased checker life. Checker chamber heights are being increased with resulting heat economies. The increase in checker height has in most cases been the result of glass working machines requiring greater factory floor to glass line elevations, rather than any direct attempt on the part of designers to increase their heights.

Temperatures

Further economies are effected by the use of thicker silica crowns and crown insulation. Insulation is being used on high temperature furnaces with excellent results. Two and one half inches of insulation on the average

(*Continued on page* 562)

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During October

Compositions

A. G. Pincus of Southbridge, Mass., has assigned to American Optical Co. his patent 2,359,789 covering glass compositions having aluminum metaphosphate as the primary batch constituent. Following are compositions representing the range as well as a specific example:

	Range	*Typical*
P_2O_5	45 to 80%	68%
Al_2O_3	8 to 25	16
SiO_2	1 to 30	16

A glass such as that in the right hand column is said to have a strain temperature of about 750° C and a softening temperature of about 880° C and to melt at about 1400° C to develop high transparency. Pincus states that his glasses are resistant to chemical attack and to thermal shock. Using this type of batch for a base, the addition of ferrous oxide produces a heat absorbing glass such as is used in projection machines for absorbing the heat of the infra-red rays produced by the light source, so that the heat cannot attack the film to cause combustion or less serious injury.

The glasses patent 2,360,280 developed by Thomas W. Rolph and Samuel J. Harris of Newark, Ohio, (Holophane Co.) are intended for use as cover glass or shields in infra-red lamps where it is desired to reduce the glare by absorbing visible light without impairment of the transmission of the infra-red. They use more or less ordinary base compositions such as one consisting of 73 per cent silica, 17 per cent soda, and 8 per cent lime, to which additions are made which have the absorbing characteristics. For example the desired transformation is obtained by adding 0.5 per cent chromic oxide to the base. This affects ray transmission properties as follows:

	Heat transmission (Infra-red)	Light transmission
Base glass	81%	90%
Base with added chromium	77%	29%

Similar change of the heat and light transmission values are reported by using certain other additions such as manganese oxide.

Feeding, Forming and Shaping

Fig. 1 illustrates in part the machine patented by Edgar P. Dorman of London, England, and assigned to The United Glass Bottle Manufacturers Ltd. for removing moiles from tumblers. In the apparatus of this patent, 2,361,824, a whole ring of burners is caused to rotate around the stationary tumbler with jets playing on the line of separation; then the glass is stretched without causing separation, and next the thinned wall is allowed to cool and finally the thinned section is reheated to complete the separation. In Fig. 1 the rings of burners are the three spoked units at the left. They are driven by an endless cable 19.

Fig. 2 from patent 2,361,553 to Paul R. Luertzing of Vineland, N. J., shows a ring shaped glass article being discharged from a split mold in which it was shaped by centrifugal force. One purpose of the invention was to provide apparatus in which containers could be made which are open on both ends and with ends finished so

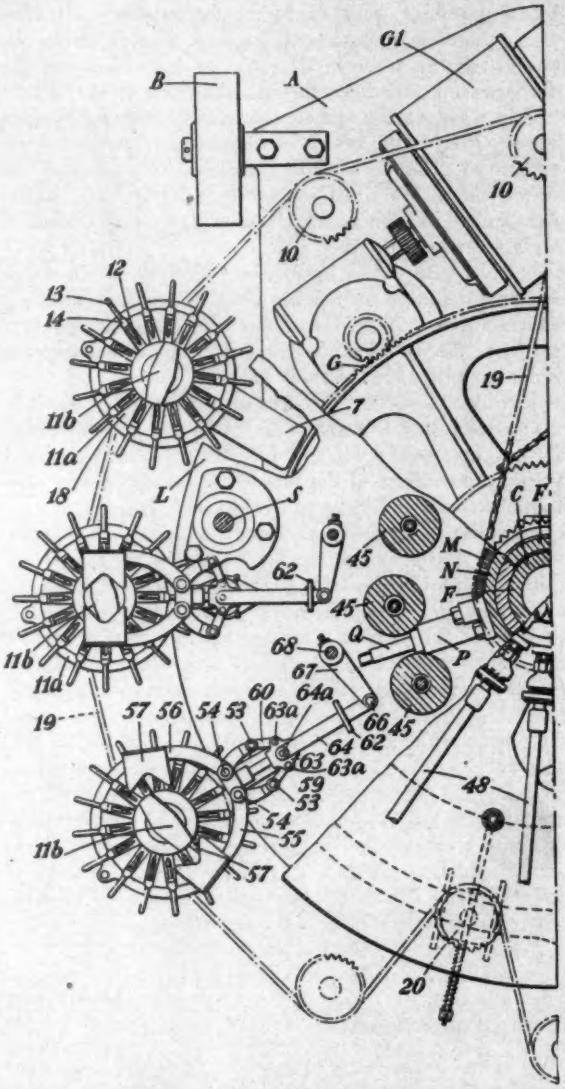


Fig. 1. 2,361,824 : Dorman. Machine for separating moiles from tumblers which utilizes a ring of small burners rotating around the workpiece.

as to be suitable for the application of heads or closures. It will be noted that there is a holder 2 which holds the mold sections together. Centrifugal force acting within the spinning rotary mold causes the glass to flow over the mold surface and no other forming means is used.

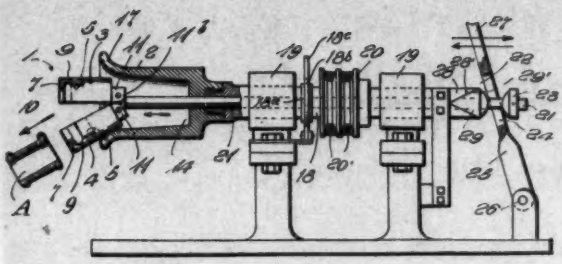


Fig. 2. 2,361,553 : Luertzing. Centrifugal machine for forming glass cylinders open at both ends.

Patent 2,359,798, granted to Seymour Schumann of New York, relates to a method of making glass beads wherein soft glass from the tip of a heated rod is stamped into a mold and immediately afterwards pierced by a needle to provide the threading hole.

Miscellaneous Processes

An Owens-Illinois Glass Co. patent for annealing tumblers is 2,361,484, granted to Casper J. Lanzinger of Toledo, in which he describes apparatus which anneals while the moile or excess glass is being removed. The tumbler is rotated by a chuck while a ring burner plays against the line at which the glass is to be severed, and simultaneously the tumbler is heated for strain removal by a multiplicity of small jets playing against its sides. Lanzinger suggests that after the tumbler has been reheated in this manner that it be cooled rather quickly in a short lehr where the temperature may be controlled.

Types of transfer machinery suitable for transferring glassware from one conveyor to another are described in patents 2,359,432 and 2,359,433, granted to Wm. L. McNamara of Lancaster, Ohio, and the Anchor Hocking Glass Co. Both are rotating turret machines with the ware picked up by suction. Features of the machine described in the latter patent are illustrated by Fig. 3. One of the pickup heads is shown in position to lift a glass dish from the right hand conveyor. A feature of the mechanism is that the instant the suction head is sealed by contact with an article, the pressure build-up immediately actuates movement to lift the ware to a higher level. This is extremely useful and essential in such applications as those where the dish would be resting on a cupped holder which would need to be cleared before there could be any lateral movement of the head. However, to provide for failure of the apparatus to complete the pick-up, the heads are so jointed as to allow them to bend sideways. The turret operates by a cam on cam rollers, these devices being concealed by the housing in Fig. 3.

Patents covering the manufacture or application of prisms are 2,361,514, granted to Edgar D. Tillyer, D. P. Bernheim and C. G. Silverberg of American Optical Co., and 2,361,050 to O. H. Paddock of Libbey-Owens-Ford Glass Co. The first of these concerns polishing operations for roof prisms. Mr. Paddock's patent relates to the construction of periscopes for land equipment such as tanks, utilizing two prisms placed close together but with a metal tube connecting them with complete sealing of the space between. Both prisms would be made of tempered glass. If a shell should strike the exposed prism the sealed space would serve to cushion the shock to the viewpiece to reduce the likelihood of its breaking with possible injury to the operator.

A household glass coffee maker is described in patent 2,360,569, granted to Joseph Masin of New York. Deo R. Mattoon of Corning, N. Y. (Corning Glass Works), received patent 2,360,570 for a coffee container or glass basket for such a percolator, the basket being built with slots in the bottom or sides to serve as the filter.

A series of inventions for sealing glass tubes to stems or end sections by heat generated by induction is covered by three patents granted to Arthur J. White of Cleveland Heights, Ohio (General Electric Co.). These are 2,359,500, 2,359,501 and 2,361,517. Anthony J. Marshaus is co-inventor in the third patent. In one application of these principles a flared glass stem is laid on a carbon ring and the end of a glass tube or bulb is brought into contact with it; a metal coil connected to a source of high frequency power is then brought into a position where it will heat the carbon ring by induction and conduct heat to the glass units to unite them.

Patent 2,359,644, granted to Glenn M. Hoey of Seattle, describes an ampoule opener. Improvements in ophthalmic lenses are covered by patent 2,361,589, granted to A. H. Bennett, R. S. Estey and H. H. Styll, and assigned to American Optical Co. They build up a compound lens with a thick body made of clear plastic but with thin cover glasses of glass to provide scratch resistance. The two materials are interlocked or keyed together.

(*Continued on page* 568)

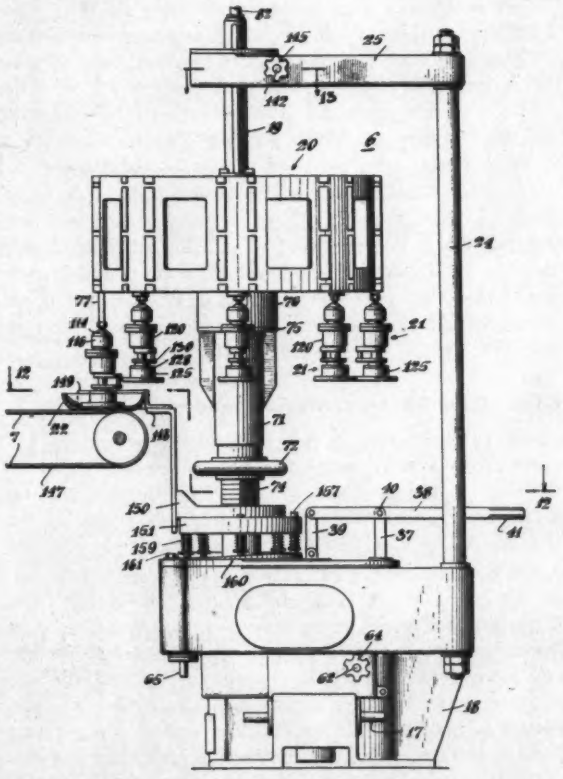


Fig. 3. 2,359,433 : McNamara. Transferring machinery which lifts by suction and which can handle a variety of ware from one level to another.

GJ Research Digest

Practical Interpretations of Glass Technology

Melting Rate of Soda-Lime Glasses as Influenced by Grain Sizes of Raw Materials and Additions of Cullet

In the August, 1944, issue of the *Journal of the American Ceramic Society*, Potts, Brookover and Burch have reported on the results of an investigation on the melting rates of glasses. This is one of a series of studies which have been made and are being made on this general subject by the research laboratories of the Owens-Illinois Glass Company.

Using the complete solution of the silica grains in the batch as a measure of the rate of melting, a series of soda-lime glass batches, in which the grain sizes of the various raw materials were varied and various amounts of cullet were used, were melted in a laboratory furnace of special design at a temperature of 2600° ± 3° F.

From the data obtained it was concluded that: 1 — When the grain sizes of all the raw materials are the same, the glasses become batch free at a rapidly increasing rate as the mean grain sizes are reduced; 2 — If the grain sizes of the materials are different, the time required for the glass to become batch free is increased, probably due to batch separation during melting; 3 — When the grain sizes of the raw materials differ, the addition of cullet tends to minimize separation during melting and thus reduce the time required for the glass to become batch free. The first increments of cullet added appear to have the most marked effect in reducing the time required to obtain batch-free glass.

Further tests were made on five commercial container-glass compositions which had raw materials of the same grain-size distribution as those in commercial use. These experiments indicated that the addition of cullet had a varying effect in decreasing melting time and it was stated that this variation of results, however, could not be explained solely on the basis of matching or mismatching grain size distribution.

Glass-Tank Regenerator Refractories

An excellent and comprehensive review of the important characteristics of the many different types of refractory materials used in glass-tank regenerators is given by Brashares in the August, 1944, issue of the *Bulletin of the American Ceramic Society*.

Silica, high heat duty fire-clay, super duty fire-clay, 50 per cent, 60 per cent, and 90 per cent alumina are discussed and their advantages and disadvantages outlined. In addition to these, newer types (as far as checker use is concerned) such as magnesite and fosterite are described. In the case of chrome refractories sufficient data was not available to indicate whether or not this type of refractory has any particular advantage.

In discussing checker design it was stated that with a refractory of a given heat capacity, it is possible by the design of the checker brick to vary considerably the amount of brick material per cubic foot of checker work and the proportion of free or open space for the circulation of incoming gas and air and outgoing waste gases. The combination most desired is the maximum weight or brick per cubic foot and a maximum amount of free space to minimize clogging and resistance to flow of the gases. Turbulence of gas flow is of importance in checker efficiency and, as it may be desirable to increase the turbulence, checker design should be considered. It may at times be necessary or desirable to clean the checker-work at regular intervals with a steam lance or similar equipment. Designs are available which make cleaning convenient.

In discussing future developments it was stated that with the marked progress in recent years in the field of regenerator refractories, it is difficult to predict the course of developments in the immediate future. A much denser fire-clay brick of high silica content, however, may possess real merit. Tank blocks have been produced for years with a high silica content. Silica brick and siliceous fire-clay bricks although of advantage chemically have relatively high porosity. This permits the penetration of the alkaline fluxes with the attendant increased severity of chemical attack. Progress is being made with a siliceous fire-clay refractory of considerably greater density than heretofore produced. With its relatively high silica content, it seems reasonable to expect it to keep free from accumulations as a result of its gradual wearing away. By virtue of its greater density, however, it is logical to expect the rate of wear to be slow.

Several years ago, a brick of the spinel type was investigated in a preliminary manner for its utility in glass-tank regenerators. Although of the general spinel chemical composition, the brick may or may not have had the spinel developed to any great degree. Tests indicated promise, however, and a refractory of this type may prove worthy of further investigation.

Modifications in the fosterite and high-alumina refractories may also be promising contributions to future developments.

WESTINGHOUSE ANNOUNCES MANUFACTURE OF EIGHT-FEET LONG LAMPS

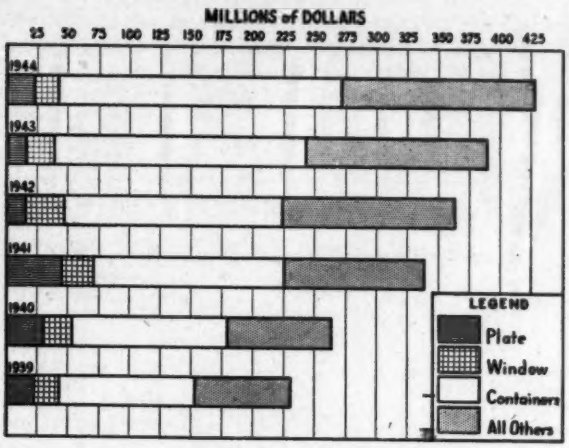
As soon as war conditions permit, the Westinghouse Lamp Division, Bloomfield, New Jersey, will manufacture slender fluorescent tubes eight feet long and producing the effect of a long ribbon of soft, cool electric light. The new "slimline" lamps were developed primarily for showcases, wall cases and coves in stores, restaurants and other places where a long, slim light source is desired.

The new streamline lamps consume about half the wattage per running foot of tube as the fatter standard types and produce slightly more than half as much light per running foot.

CURRENT STATISTICAL POSITION OF GLASS

THE GLASS INDUSTRY'S INDEX

Production Nine Months, January Through September



September figures showed a slight decrease of activity in the glass industry from that reported for August. As indicated by the Production Index, production for September was $47,000,000, as compared with $48,000,000 for August and $45,000,000 for September, 1943. Output for the first three quarters of 1944 was $428,000,000, comparing with $393,000,000 for the same nine months of 1943—an increase of approximately 8 per cent.

Plate glass production for October was reported to be 9,104,848 sq. ft. by the Hughes Statistical Bureau. This figure is slightly higher than the one shown for September. However, the 1944 October production is reported at about 34 per cent over that of October, 1943. A total of 87,305,759 sq. ft. has been produced during the first ten months of 1944, compared to 59,632,204 sq. ft. reported for the same period last year—an increase of approximately 46 per cent.

Glass container production for October was reported at 8,600,671 gross, by the Glass Container Association of America. This is an increase of 11 per cent over the figure shown for September, and also a very slight increase over that reported for October, 1943. During the first ten months of 1944 glass container production rose to 84,157,944 gross, as compared to 77,223,350 gross for the same period of 1943—an increase of about 9 per cent.

Shipments of glass containers during October totalled 8,187,346 gross, an increase of about 8 per cent over September, and a decrease of 3 per cent from October, 1943. Total shipments reported for the first ten months of 1944, were 81,268,557 gross—an increase of 3 per cent over the same months of last year.

Inventories on glass containers for October were 5,393,974 gross, showing a slight increase reported for September and an increase of 10 per cent over October, 1943.

Automatic tumbler production for October totalled 5,859,772 dozens, a decrease of 10 per cent from the figure reported for September, and an increase of 12 per cent over October, 1943. Shipments of automatic tumblers for the month of October totalled 5,023,806 dozens, a decrease of about 20 per cent from September and a slight decrease from the figure for October, 1943. Finished stocks on hand at the end of October were reported at 7,285,534 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware for October were reported at 3,352,526 dozens, an increase of 10 per cent over September and a 49 per cent increase over October of the preceding year.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures Are in Gross)

		Production Oct. 1944	*Stocks Oct.* 1944
Foods; Medical & Health Supplies; Chemical, Household, Industrials; Toiletries & Cosmetics	Narrow Neck	2,987,448	1,892,880
	Wide Mouth	2,747,836	1,740,175
Dairy Products		272,862	351,141
Home Canning		83,404	326,469
Beverages		576,960	323,546
Beers		796,421	257,472
Liquors		779,276	375,932
Wines		289,543	103,900
Packers' Tumblers		66,921	22,459
Total		8,600,671	5,393,974

GLASS CONTAINER SHIPMENTS

(All Figures Are in Gross)

Narrow Neck Containers	*Oct.* 1944
Foods	773,899
Medicinal & Health Supplies	996,911
Chemical, Household, Industrials	578,525
Beverages	535,839
Beers	749,214
Liquors	693,570
Wines	253,797
Toiletries & Cosmetics	508,275
Sub-Total (Narrow Neck)	5,090,030
Wide Mouth Containers	
Foods	2,226,199
Dairy Products	246,896
Home Canning	41,356
Medicinal & Health Supplies	241,915
Chemical, Household, Industrials	161,093
Toiletries & Cosmetics	118,567
Packers' Tumblers	61,290
Sub-Total (Wide Mouth)	3,097,316
Total shipments	8,187,346

Attention . . .

Glass Tank Operators

***For Maximum Life* SPECIFY**

C · S · R

CAST SUPER REFRACTORY

For

Mantels, Feeder Parts, Tuckstones, Burner Blocks, Port Covers, Port Bottoms, Port Arches, Port Skews, Port Baffles, Lintels, Jambs, Bridgewall Covers, etc.

C.S.R. *has excellent resistance to*

HIGH TEMPERATURES

CORROSION

SHRINKAGE

SPALLING

C.S.R. *is*

VACUUM CAST

ACCURATE TO SIZE

UNIFORM TEXTURE

ECONOMICAL

●

Write for Full Particulars

WALSH REFRACTORIES CORP.

High Grade Refractories for Over 50 Years

4070 NORTH FIRST STREET ST. LOUIS 7, MISSOURI

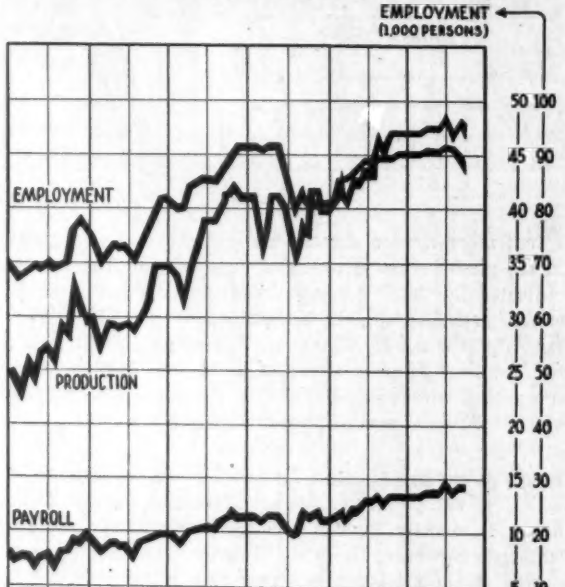
Miscellaneous glass products manufactured in September were estimated at $17,000,000—the same as that reported for August. This is also the same figure as that shown for September, 1943.

Employment and payrolls: The total number of persons employed in the glass industry during September was 88,300. This compares with 90,000 employed in August, and 89,500 employed in September, 1943.

Payrolls for September were estimated at $14,500,000—the same as the August figure. During the first three quarters of 1944 glass manufacturers have paid approximately $127,000,000 in salaries.

GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through September, 1944



GLASS SPECIALTIES

Transparent Colored Blown Sheet Glass
Solid Pot Opal Blown Sheet Glass
Flashed Opal Blown Sheet Glass
Colonial Antique Colored Glass
Heat-Ray Resisting (Cool Glass)
"TWIN-RAY"—the scientific illuminating glass.

HOUZEX

L. J. HOUZE
CONVEX GLASS CO.
Point Marion, Pennsylvania
New York Office: 110 West 40th St.
Chicago Office: 1597 Merchandise Mart
"IF IT'S MADE OF GLASS, ASK US FIRST"

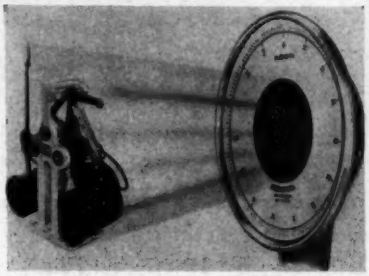
NEW EQUIPMENT AND SUPPLIES

HIGHLY SENSITIVE PRESSURE GAUGES RELEASED

The Brown Instrument Company, Philadelphia, is now making available for industry new spring and bellows actuated pressure gauges that measure ranges between zero and five inches, and zero and 50 inches of water.

Two new types of gauges are being introduced. One gauge has a single spring for pressure ranges, the other has a second spring, in tandem with the first, for vacuum and compound ranges. Applications of the new models include combustion pressures and steel, petroleum, chemical and aviation engine manufacturing, processing and testing.

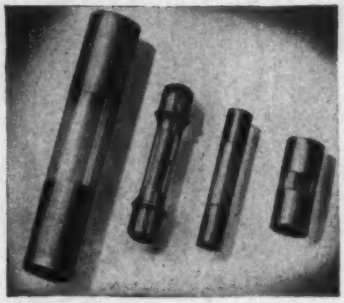
IMPROVED KRON DIAL MECHANISM



After years of research and development by the Yale & Towne Manufacturing Co., Philadelphia, the improved Kron ball bearing, springless dial mechanism of the double pendulum type is the precision-built "brain" around which every Kron Scale is designed and made. Because of its extreme sensitivity it speeds weighing, counting, batching, measuring and testing operations with accuracy and dependability by reducing these operations to a simplified "load and look" procedure.

Featuring specially designed ball bearings to eliminate wear at bearing points, the gear sector and shafts carrying the indicator and pendulum arm weights are all mounted in fixed centers. This assures alignment at all times and prevents these parts from being unseated even when they are subjected to shocks or jarring vibrations.

Friction and wear of the dial indicator shaft and sector gear teeth are minimized through an auxiliary sector which absorbs backlash. A special non-vibrating sector can be incorporated in the mechanism to practically eliminate the effect of any outside vibration. Shocks and variations of temperature are completely compensated for by an adjustable and non-leakable oil dashpot. This entire dial mechanism is interchangeable in all Kron scales regardless of capacity or type.



METAL PLATING ON GLASS

The unusual adhesion obtained by Electro Plastic Processes, Chicago, in plating on plastic materials has been further adapted for application to glass and ceramics. Tests on PYREX glass have been conducted by heating the solder sealed piece to 350° F. and immersing it immediately into dry ice, indicating the adaptability of the new process for all temperature ranges.

The process is adaptable to the hermetic sealing of such electrical components as resistors, condensers, small relays, transformers, instruments, etc. Either glass or ceramic cases can be plated with a metallic band for soldering to metallic end caps or insulators plated for solder sealing to metallic containers.

APPARATUS SPEEDS INSULATING

Glass plant operators will be interested in a new gun, designed by the Illinois Clay Products Company, Chicago, to speed up the sealing and insulating of refractory walls.

This Gun syphons dry THERMO-O-FLAKE Insulation direct from the shipping carton, mixes with water and sprays to the refractory wall in one operation. Premixing is eliminated. The Gun operates on standard air and water pressures and application is six to eight times faster than by manual methods.

CATALOGUES RECEIVED

The Howe Scale Company, Rutland, Vermont, has just published a booklet (P-1) showing a wide variety of Counting Scales in many styles and capacities. Included are single, double, triple, and all-ratio models with Weightograph, Dial and Beam Indication.

Among the eleven types illustrated is a new addition to The Howe Line—a double-ratio scale with a special third pan said to be especially adapted for counting small parts because of the unusual high sensitivity provided by this third pan which is attached to the lower beam lever. This Fan Bench Type Scale is designed for the quick, accurate counting and weighing of materials in shipping, receiving and production departments, as well as for inventory and similar counts of small parts.

Leeds & Northrup Company, Philadelphia, is distributing their Folder ENT(7a) which will be of interest to any industrial man with a problem to be solved through the use of measuring instruments and controls. This booklet briefly describes all L&N products for regulating plant processes.

Because so many of these processes depend on close temperature regulation, one section of this 28-page "General Catalogue" issue of "Modern Precision" describes the instruments for measuring by each of L&N's four pyrometric methods. For other plant processes, equipments which measure such quantities as pH, speed, gas analysis, etc., are described. A large chart shows the particular instrument model which is available in each case . . . installation photographs show the equipments in service.

The Battelle Memorial Institute, Columbus, Ohio, has just issued a very handsomely executed booklet describing activities at Battelle entitled "Research in Action." The booklet describes the different divisions of research and the work being carried out in each division. This 56-page publication is well written and profusely illustrated by photographs so that the reader gains some knowledge of the activities of this organization which was founded in 1929 for the purpose of conducting research for industry on a non-profit basis.

General Electric, Schenectady, N. Y., has published a 96-page book entitled "Industrial Electronics" describing some of the electronic applications made by General Electric. Two pieces of equipment which would prove especially interesting to the glass industry are the Photoelectric Pyrometer which provides a unique and entirely dependable method of indicating and recording temperature; and an Electronic Weight Measure which automatically proportions the weights of two materials delivered to a mixing bin by two conveyors. The book is well illustrated with photographs and diagrams.

CATALOGUE & BULLETIN SERVICE

Current catalogues and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

They're Going Overboard For Victory—Are YOU?

USE 8-POINT PLAN FOR AN OVERBOARD DRIVE IN THE 6th WAR LOAN!

NOV. 20th TO DEC. 16th

Our fighting men still have a long way to go! But—your plant-wide selling of the 6th can do much to shorten their embattled miles—lessen the price they so willingly pay for victory! Join the coast to coast parade of patriotic firms that are assuring an **"overboard" showing in the 6th** by following through on **every** point in the 8-Point Plan.

Start the ball rolling by appointing a **6th War Loan Bond Committee**, representing labor, management and other groups.

Carry on by selecting a **Team Captain**—preferably a returned veteran—for every 10 workers.

Right at the start, establish a **Quota** for each department—and every employee.

Arrange frequent **Meetings** of Captains, highlighting importance of their work—effective sales methods—and need for painstaking study of **Treasury Booklet, Getting The Order.**

6th WAR LOAN

Make definite **Assignments** to those best equipped to arrange music, speeches, rallies, competitive progress boards and meeting schedules.

Issue **Individual Pledge Cards**—made out in the name of each worker and providing for both cash and installment purchase.

Resolicit! This is the secret of "overboard" War Bond subscriptions. Your State Payroll Chairman has a special Resolicitation Plan for you to put into action near the end of the campaign.

Give generously of your **Advertising Space** to drive home the War Bond story.

The Treasury Department acknowledges with appreciation the publication of this message by

THE GLASS INDUSTRY

★ *This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council* ★

Now $3.50

HANDBOOK of the GLASS INDUSTRY

• The first printing of the Handbook of the Glass Industry has become exhausted and the continued demand for copies has resulted in a second binding.

Through printing economies obtained by a lowered unit cost in the second printing of the Handbook we are able to offer this useful, ready reference glassman's handbook at the *reduced price of $3.50 per copy.*

The Handbook of the Glass Industry is the only quick ready reference glassman's handbook for general factory manager, superintendent, combustion engineer, chemist, department foreman and every glassman regardless of his title or job.

The supply of this second binding is nearly exhausted, so may we suggest that you enter your order now!

THE GLASS INDUSTRY
55 West 42nd Street
New York 18, N. Y.

Date.....

Please enter my order for.....copies of the Handbook of the Glass Industry at $3.50 per copy.

Name..... Company.....

Address .....

.....

with liberty the theme...

HAPPY NEW YEAR
1945

FREEDOM of Opportunity is an American heritage. It is this, more than all else, that has made America great.

We hope that 1945 will offer each of you more abundant means for turning "the American way" to better account, that each day will bring you more and richer blessings.

With this in mind we wish you all a very Happy New Year.

O. HOMMEL CO.
209 FOURTH AVENUE
PITTSBURGH 30, PENNA.
World's Most Complete Ceramic Supplier

FORTER-TEICHMANN CO.

Engineers and Contractors

for

The Glass Industries

E-X-C-L-U-S-I-V-E-L-Y

119 Federal Street, Pittsburgh, Pa.
Phone FA 1445 Cable "Forter"

IMPROVEMENTS IN FURNACE DESIGN . . .

(*Continued from page* 553)

silica crown will reduce the heat loss by approximately 35 per cent.

With higher furnace output per square foot of melting area, follows an increase in furnace temperature. This increase in operating temperature causes the furnace bottoms to run hotter. To protect the bottoms and make the furnace less sensitive to temperature changes, a definite trend is towards the use of deeper furnaces.

The increased furnace operating temperatures also requires that special attention be given to furnace cooling. Water coolers on the throat cover and facing blocks are being universally used. The design of the furnace throat has not materially been altered in the past 4 years. The tendency to increase the throat width was found to give sidey operation. Investigation of the furnace throat following a shut-down indicates that the flow of glass through wide throats is not uniform and therefore, not conducive to the best operating results.

Auxiliary Fuels

Up to this point, furnace design is pretty much the same regardless of the type of fuel used. Because of the tremendous demand for natural gas in defense industries we find many glass plants deprived of its use and forced to use oil. This conversion was not always as simple as the Government fuel experts would have us believe. In addition to being deprived of gas, the fuel oil made available was heavy oil which is usually high in sulfur content. The type of fuel used determines the furnace design.

Furnaces using producer gas have undergone very little change in fundamental design. Improvements in general consist of closer attention to details. Natural gas fired furnaces are in general operating on low pressure firing which permits operation with a soft high emissivity flame. Few changes in fuel application have been made on natural gas fired furnaces.

Possibly the greatest change in furnace design resulted when the conversion of furnaces from natural gas to fuel oil firing had to be made permanent. In many cases it has been necessary to convert immediately on operating furnaces. In some cases this was done with minimum difficulty. The quickest conversion to oil firing is the installation of burners in the back wall of the furnace. On large furnaces operating at high tonnage, side firing still has its advantages and is giving the best results. On existing operating furnaces, oil burners have been installed to fire through the conventional gas burner blocks. Using steam for atomization purposes. The use of steam aided materially in retarding the rate of combustion and very satisfactory results have been obtained with a minimum of damage to the furnace port bottoms and jambs. Furnaces fired in this manner showed operating economies on a par with gas performance.

Oil Firing

High pressure compressed air atomization oil burners are still the preferred type. A very satisfactory way to apply oil is shown in Fig. 8. In this design the oil is introduced both above and below the port. Over the port firing is well adapted to furnace 16 feet and greater in width. A combination of over and under port firing give very fine control of flame length and coverage. This application requires special structural design and is not readily installed on existing furnaces without major structural changes. Above the port firing lends itself readily to existing furnace designs.

In the past it has always been the practice to use as few burners as possible. We now find that limiting the burner capacities to 50 gallons of oil per hour and less provides for better flame control and coverage. Limiting the maximum oil flow to 50 gallons per hour prolongs the life of the burner and port structure.

Special Furnaces

Up to this point, we have considered only the conventional types of glass melting furnaces. Considerable work has been done in the field of electric melting. There have also been developed several unorthodox types of furnaces for special melting applications.

Electric melting is an interesting development that no doubt will some day be given publicity and we believe the results will be startling to most glass men. The same can also be said for the work that is being done on special furnaces.

In conclusion, the past three years of glass furnace design and improvement has naturally been hampered through priority control of material and equipment, but the postwar period should see many war time innovations incorporated in glass furnace designs that will improve their operation, output and the quality of product produced.

A paper delivered at the Eighth Urbana Conference on Glass Problems.

FIBERGLAS MATERIALS NOW USED IN MEDICAL SCIENCE

"Pioneering Uses of Fiberglas in Medicine," a booklet just published by the Owens-Corning Fiberglas Corporation, provides the first complete account of how the medical profession is using Fiberglas materials in research, and in the treatment, alleviation and prevention of human ills.

Several of the uses described are still in the experimental stage and require further development, while others are now helping physicians and surgeons obtain improved results in treating the sick and wounded.

Some of the uses included are: Measurement of Nitrogen Loss in Exudate from Burned Skin, Tracer Threads in Surgical Sponges, Experimental Surgical Sutures, Blood Plasma Filters, Penicillin Production, Fiberglas-Plastic Artificial Limbs, etc.

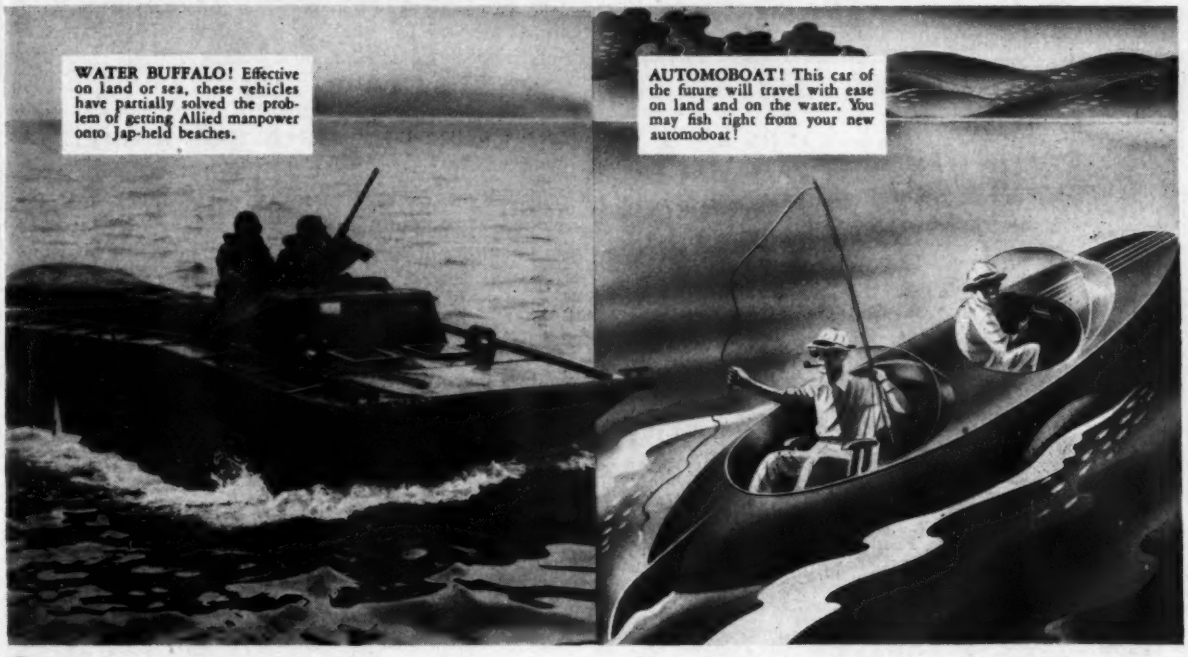
PITTSBURGH PLATE TO EXPAND FACILITIES AT MT. VERNON PLANT

Announcement has been made of plans for a $700,000 addition to the production facilities of the Pittsburgh Plate Glass Company's Mt. Vernon, Ohio, window glass plant.

Enlarging the scope of operations is part of the preparedness program of this company to meet its present war production and its anticipated post-war needs.

SOLVAY*

...KEYED TO TODAY AND TOMORROW!


WATER BUFFALO! Effective on land or sea, these vehicles have partially solved the problem of getting Allied manpower onto Jap-held beaches.
AUTOMOBOAT! This car of the future will travel with ease on land and on the water. You may fish right from your new automoboat!

Today . . . Solvay alkalies are making their special contributions to the manufacture of war machines. In the service of industry since 1881, Solvay is America's largest producer of alkalies. Three strategically located plants supply the needs of war-time industry.

Tomorrow . . . Solvay's vast production facilities will be keyed to the revolutionary possibilities of mechanical invention. And all industry can continue to look to Solvay for highest quality alkalies . . . for in peace as in war Solvay Alkalies serve the nation.

SODA ASH • CAUSTIC SODA
AMMONIUM CHLORIDE • CAUSTIC POTASH
MODIFIED SODAS • AMMONIUM BICARBONATE
SODIUM NITRITE • PARA-DICHLOROBENZENE
CALCIUM CHLORIDE • CHLORINE • SALT
POTASSIUM CARBONATE

SOLVAY SALES CORPORATION
Alkalies and Chemical Products Manufactured by The Solvay Process Company
40 RECTOR STREET NEW YORK 6, N. Y.
BRANCH SALES OFFICES:
Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit
New Orleans • New York • Philadelphia • Pittsburgh • St. Louis • Syracuse

SOLVAY
TRADE MARK REG. U. S. PAT. OFF.
*

THE SHARP-SCHURTZ COMPANY

CHEMISTS AND CONSULTING ENGINEERS

FOR THE GLASS INDUSTRY

LANCASTER, OHIO U. S. A.

For All Types of Glassware Moulds & Grey Iron Castings

OVERMYER MOULD COMPANY

Winchester, Indiana

For All Types of Glassware Moulds

OVERMYER MOULD CO. of PENNA.

Greensburg, Penna.

For Screw Machine Products

OMCO PRODUCTS CORPORATION

Springfield, Ohio

MAIN OFFICE . . . . WINCHESTER, INDIANA

GAS·AIR·OXYGEN

BURNERS

ECONOMIZERS

MIXERS

GLASS ROLLERS

GENERAL GLASS WORKING EQUIPMENT

Glass working equipment manufacturers: glass ampules, vials, etc. Glass working lathes, bench fires and laboratory equipment of all types. Write for catalog

CHAS. EISLER

EISLER ENGINEERING CO.

742-50. 13th STREET

CALUMITE NEW GLASS BATCH MATERIAL

R. W. Hopkins, formerly associated with the Owens-Illinois Glass Company, has announced the organization of The Calumite Company, at Hamilton, Ohio. This company is set up to sell and develop the use of by-product calcium aluminum silicate in the ceramic industry, particularly in glass.

Mr. Hopkins received the degree of Bachelor of Ceramic Engineering from Ohio State University in 1931 and Professional degree in Ceramic Engineering in 1941 from the same university. For the past thirteen years he has been connected with Owens-Illinois in a technical capacity both in the General Engineering department and at the various plants, most recently being Laboratory Supervisor at Charleston, West Virginia.

WESTINGHOUSE SEARCHLIGHT READY FOR DUTY ABOARD NAVY SHIPS

Engineers at Westinghouse Electric Company have developed a signaling searchlight tough enough to stand the pounding of heavy waves and the shock of big guns fired close by, and the light is now ready for duty aboard our warships

The searchlight flashes its message in code by projecting a beam of light through a series of Venetian-blind shutters that are opened and closed by hand to simulate dots and dashes. On a clear night the beam is visible for 17 miles.

A special heat-resisting glass, ten times stronger than plate glass, enables the searchlight to resist sudden changes in temperature. Icy cold waves lashing against the lens of the searchlight while it is still hot would instantly shatter ordinary glass, but to prevent that Westinghouse has used a special glass which can be heated to a very high temperature and then plunged into ice water without showing the slightest strain.

INTERNATIONAL LIGHTING EXPOSITION TO BE HELD IN CHICAGO

Leading lamp and lighting equipment manufacturers of the United States will join together next April 19-23, 1945, in the International Lighting Exposition at the Palmer House in Chicago to unveil the newest developments in lamps and lighting equipment for industrial plants, schools, offices, etc., and at the same time show how better lighting is speeding war production. This will be the largest exhibit of industrial and commercial lighting equipment ever brought together under one roof.

As part of the Exposition there will be conducted a series of Lighting Conferences at which outstanding men in the field will discuss the latest trends in lighting practice, the most effective means of providing efficient seeing conditions for school children and for office and factory employees.

• Jack W. Forbes has just been appointed Sales Manager for the Wickwire Spencer Metallurgical Corporation, subsidiary of the Wickwire Spencer Steel Company. Prior to his association with this company Mr. Forbes spent six and a half years with the Western Electric Company.

Who will be NEXT?

IN RECENT months two of the biggest glass manufacturers have announced plans for the establishment of large glass plants in Georgia.

This expansion of the glass industry in Georgia is a natural, logical step.

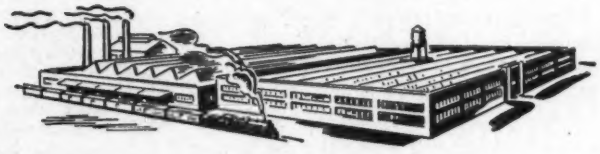
WHO WILL BE NEXT to take advantage of the manufacturing and distribution economies, and better service to Southern consumers which a Georgia location affords?

Here are all the important elements in the manufacture of glass: silica sand, lime and limestone, salt cake, soda ash, feldspar, natural gas and dependable electric power.

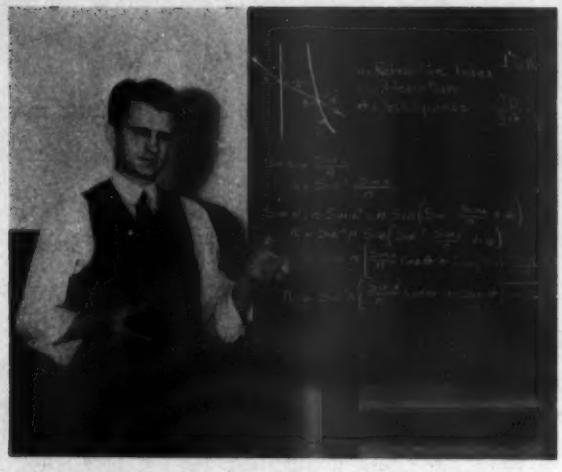
In Georgia you are in the center of the Southeastern market with excellent railway and highway transportation facilities in all directions.

Georgia's mild climate contributes to savings in plant investment, production costs and in living cost of workers. The post-war supply of friendly, intelligent, willing, easily trained, native-born workers will be ample. Georgia's business-minded government and friendly people welcome new industry.

Our industrial engineering staff has assembled accurate data on raw material sources for glass manufacturing in Georgia, together with the best locations. Write Industrial Development Division, GEORGIA POWER COMPANY, Atlanta, Georgia.



PLANT the Future in GEORGIA



Dale W. Rinehart displays a square of the newly-perfected camera glass. In the background is a portion of the formula worked out for this product.

PITTSBURGH PLATE PERFECTS CAMERA GLASS

One of several "this just can't be done" jobs performed for Uncle Sam by the Research Division of the Pittsburgh Plate Glass Company was to provide quickly a large supply of plate glass through which aerial photographs could be taken from heights exceeding six miles, with such accuracy that railroad ties could be counted from the ground.

Several had reported such a job was impossible and that the glass would have to be ground like lens for cameras, which would have entailed very high cost and provided very little glass at a time.

The government was saved thousands of dollars in Pittsburgh's process which cut costs to less than one-third that of specially ground glass, and our fliers were assured of returning with accurate pictures. Dale W. Rinehart, research expert at the Glass Division Research Laboratory of the Company at Creighton, determined to what extent light rays are deviated by relative surface contours and other factors in passing through a glass window, and to what extent an image formed on the plate of an aerial camera would be distorted by such deviation.

To correct any possible blurs in pictures, it was found necessary to hold to tolerances almost unbelievably small in flat glass. The thickness of a certain type could not vary in a one-inch length by more than three ten-thousandths of an inch—and this thickness change itself could not vary in a rate along the inch length by more than several millionths of an inch per inch.

Very critical examination is required of each window to insure that photographs taken at any angle up to a specified limit will be sharp and undistorted. This meticulous inspection is done with a unit simulating that used in actual aerial photographic work under the most critical conditions for the particular installation.

• Bailey Meter Company, Cleveland, Ohio, has announced the appointment of P. S. Dickey as Chief Engineer. Mr. Dickey will supervise all Engineering, Research and Design activities for the Company. His assistants will be H. H. Gorrie, Assistant Chief Engineer, and R. E. Clark, Manager of Contract Engineering.

BATCH MIXING . . .

(*Continued from page* 547)

"glazing-over" of the batch lessens somewhat the troubles due to dusting and segregation of the batch inside of the furnace.

Future Developments

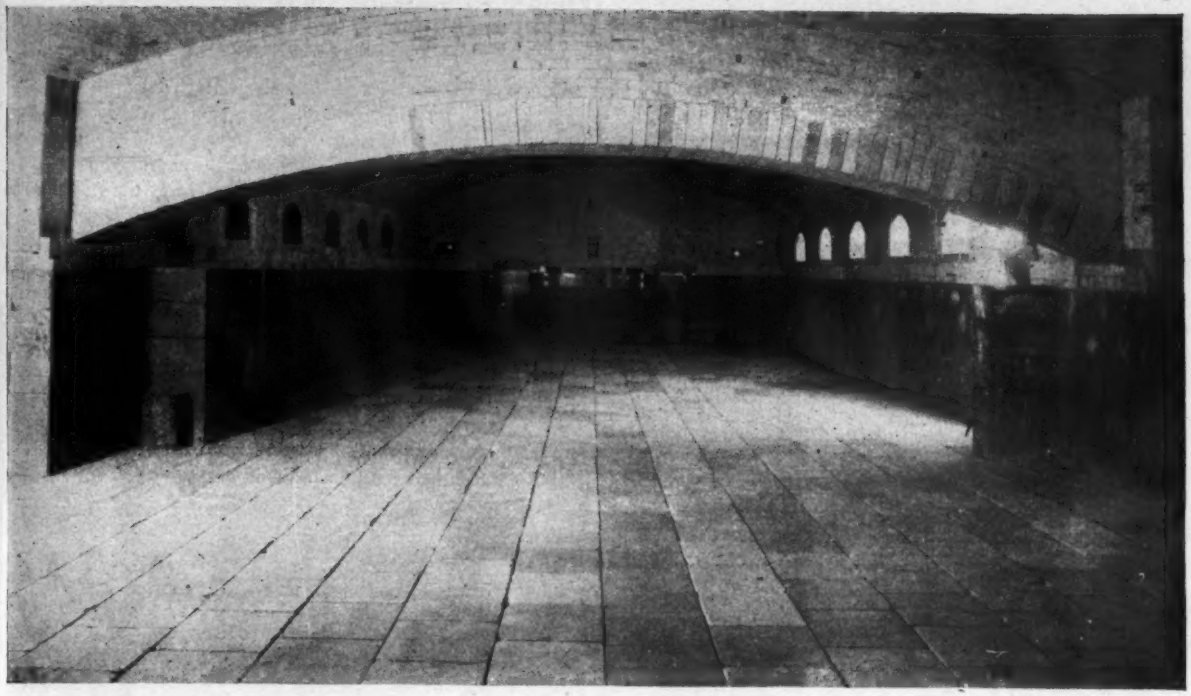
Investigations by the glass technologists have pretty well covered the effects of composition and chemical accelerators on the melting process, and the batches that are given to us to prepare and deliver to the furnace are generally compromises. Recent work indicates that the technologists are showing interest in the effect of particle size on rate of melting. The results that they obtain may greatly influence our present batching procedures. If, for example, it is discovered that finer grain size materials should be used, our problems of contamination, segregation, and others will be magnified.

Fortunately we have a head start in this direction. Some plants have investigated and are using briquetted batch. Such a process would be excellent for fine grain size materials as it not only prevents segregation but eliminates loss and inconvenience through dusting. Fig. 7. The success that the brick manufacturers have had in dry-pressing their products also may offer some worthwhile clues. While these methods are rather expensive, future developments may cause economies that will justify their use.

A paper delivered at the Eight Urbana Conference on Glass Problems.

Because of the prohibitive cost of drinking glasses in Iran, and the fact that Army medical authorities have forbidden the use of tin cups, American soldiers make their own glasses from empty beer, vodka, or squash bottles. Peter Pollack, American Red Cross Assistant Field Director, is shown here demonstrating to Lt. Pearson, Cpl. Williams and native house boys, the technique of cutting down the bottles with the aid of a blow torch and a red hot poker.

• Ralph Winslow, director of advertising and public relations for Libbey-Owens-Ford Glass Company, Toledo, Ohio, became the first glass industry representative to serve on the board of directors of the Association of National Advertisers, when he was elected to a three-year term at the association's recent annual convention in New York. The membership of this organization includes the leading advertisers of the nation.



What About Corhart* Electrocast In The Window Glass Industry?

FOURTEEN years ago we published the photograph above. The furnace shown is a unit of one of the largest manufacturers of window glass in America. Through all the years since the first Corhart installation, this unit as well as all others belonging to this large company have been similarly constructed, with liberal use of Corhart products.

As a matter of fact, of the 32 window glass tanks in the United States, Canada and Mexico, 29 have complete Corhart Electrocast throughout the sidewalls. . . . The 3 remaining tanks are largely Corhart Electrocast but embody small quantities of other materials. . . . Four of the 32 have complete Corhart Electrocast bottoms, and most of them use Corhart Electrocast extensively in the superstructure.

Furnace life and highest quality glass are the reasons for this record of Corhart service to the window glass industry.

We would be happy to send detailed information—particularly to glass companies and engineers in South America and throughout the world.

Corhart Refractories Company, *Incorporated,* 16th and Lee Streets, Louisville 10, Kentucky.

*Not a product, but a registered trade-mark.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

INVENTIONS AND INVENTORS . . .

(*Continued from page* 555)

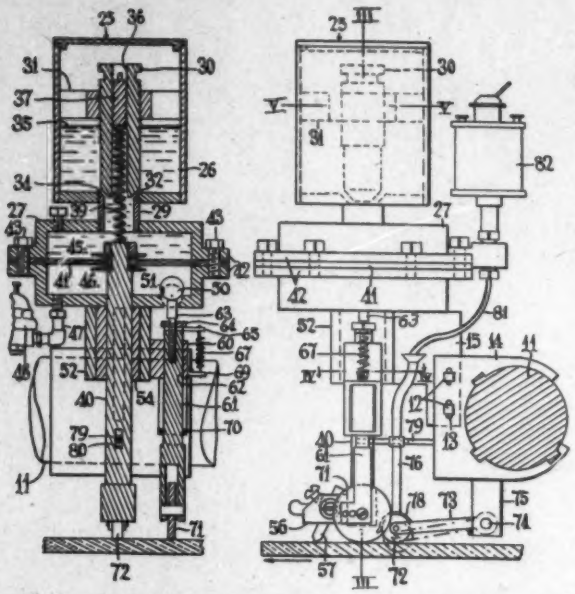


Fig. 4. 2,361,049 : Oakes. Sheet glass cutter, actuated by hydraulic fluid, with automatic release of pressure.

Sheet and Plate Glass

Fig. 4 gives two views of a glass cutter actuated by hydraulic pressure, which is covered in patent 2,361,049, assigned by Alfred C. Oakes of Mount Vernon, Ohio, to Pittsburgh Plate Glass Co. As shown in the left hand sectional view, the actuating liquid, which may be oil, is housed in an upper container 25 and a lower one 27 which are connected by needle valve. The liquid in the lower container presses against a diaphragm 41, causing it to press the cutter blade 57 (right view) against the glass. Air through pipe 47 (left) normally bears against the lower side of the diaphragm to keep the cutter inoperative. However, when the sheet of glass begins to pass under the cutter unit it presses against a roller 71 which opens the ball valve 50 to vent the air from the under side of the diaphragm; this causes the hydraulic fluid to operate the cutter. When passage of the sheet is complete and there is no longer a contact with roller 71 the ball valve closes, air pressure builds up under the diaphragm and the cutter blade is lifted.

Glass Wool and Fiber

In the familiar platinum metal bushings in which glass marbles are melted, and from the multitple apertures of which glass fibers are drawn, Ralph R. Tiede proposes to provide a series of baffles to give the glass a more circuitous path to travel. This is patent 2,360,373, assigned to Owens-Corning Fiberglas Corp. Other advantages arise from the fact that the baffles bring the glass into greater proximity with the metal walls which provide the heat for melting and fining it.

Michel B. Vilensky of Newark, Ohio, in patent 2,361,578, assigned to Owens-Illinois Glass Co., describes alloys suitable for fiber feeding parts. These consist of platinum alloyed with 0.25 to 2.0 per cent nickel.

WIREBOUND BOX MANUFACTURERS DEVELOPING SHIPPING CONTAINERS FOR GLASS

With the Association of American Railroads discussing plans for returning responsibility to the shipper for damage losses, which in 1943 totaled $931,298 for glass and glass articles, manufacturers of wirebound boxes are developing shipping containers to help meet the problem.

Through box and crate engineering, the wirebound box industry expects to meet the situation in two ways:

1. By designing and testing boxes and crates which will assure safe transit of all types of products with lighter weight and easier handling.

2. By consulting with manufacturers on how they can avoid damage losses in designing, manufacturing and packing their products.

With the help of several outstanding package laboratories, the wirebound box manufacturers create containers to fit the needs, then have them tested by scientific devices to make certain they surpass the standards set for the task. The result is as nearly perfect shipping conditions as possible, so long as the object to be shipped is designed with the shipping problem in mind and packing techniques are regulated.

With more than 500,000,000 wirebound boxes used successfully for war shipping during the past four years, the manufacturers are employing the extra skill they have acquired to solve the many shipping problems of peacetime. If the railroads should refuse to allow many previously paid damage claims, they point out, the burden will be on the shipper to make certain his products arrive at their destination safely. Since few shippers can afford to sustain such losses as have been common in the past, and paid for by the railroads, the wirebound box industry considers it an essential for all industries to become conscious of the importance of box and crate engineering.

PENSION PLAN APPROVED BY INTERNAL REVENUE BUREAU

The pension plan tentatively adopted by Owens-Corning Fiberglas Corporation, to provide retirement income for employees, has been approved by the Bureau of Internal Revenue of the Treasury Department and is now in effect.

A trust fund established by the corporation will provide retirement income, without cost to employees whose basic earnings are less than $3,000 a year. Employees whose basic earnings are more than $3,000 a year will pay a percentage of the cost.

CLASSIFIED ADVERTISEMENTS

DRAFTSMAN—We are expanding our furnace design department to meet postwar requirements and need an experienced draftsman to do furnace design drafting and detailing. Give full details of past experience, salaries drawn, and age. CORNING GLASS WORKS, Corning, New York.

FOR SALE
GLASS PLANT MACHINERY—GOOD CONDITION

Lynch R—Miller M—Lynch LA—O'Neill Lid Press—Annealing Lehr, Polariscope, Pyrometers, Arbor Press, Etc. No priorities required.

THE CANADIAN CREDIT MEN'S TRUST ASSOCIATION LIMITED
456 Main Street Winnipeg, Man., Canada

● Akin to *too little* business is *too much* business especially when it taxes facilities to "the breaking point" or requires continued high pressure production under conditions that are far from efficient.

This has been the situation with many glass plants since the start of the war during which time progress has been made in methods and equipment and newly built plants have been equipped to wage keen competition.

Sooner or later, many plants, possibly including your own, will reach a point when they *will just have to be rebuilt.* That event will present an opportunity to do a thorough job that will put your facilities in the forefront of the industry and enable you to compete with all comers—in volume—in quality—in delivery and in price.

When you reach the point of seriously considering this inevitable step let TECO Engineers sit down for a frank and thorough discussion of the subject. It will be time well spent.

TOLEDO ENGINEERING Company

GLASS MELTING and MANUFACTURING EQUIPMENT

EASTERN OFFICE 220 E. LEXINGTON ST. BALTIMORE MD. • • • 958 Wall St. TOLEDO, O.

POLAROID*

Glass Inspection polariscope

Large Field—Brilliant Strain Patterns
Adjustable- Binocular Viewing—Precise

If your problem is strain detection we can help you through Standard Equipment or Special adaptations.

Send for descriptive bulletin

THE POLARIZING INSTRUMENT CO., INC.
41 EAST 42nd STREET NEW YORK CITY, 17
*T.M. Reg. U.S. Pat. Off.

A Solution to your Combustion Problems

For 32 years we have specialized in the manufacture of Fuel Oil and Gas Burners for all types of industries, including many Glass and Ceramic Plants. The broad experience we have gained over these years enables us to provide a solution to many combustion problems. Perhaps we can help solve yours.

★ ★ ★

NATIONAL AIROIL FUEL OIL - GAS BURNERS

Write us for further information.

NATIONAL AIROIL BURNER COMPANY, INCORPORATED
1255 East Sedgley Avenue
PHILADELPHIA 34, PENNA.

ESTABLISHED 1912 **INCORPORATED 1917**

BORAX *and* **BORIC ACID**

99½-100% PURE

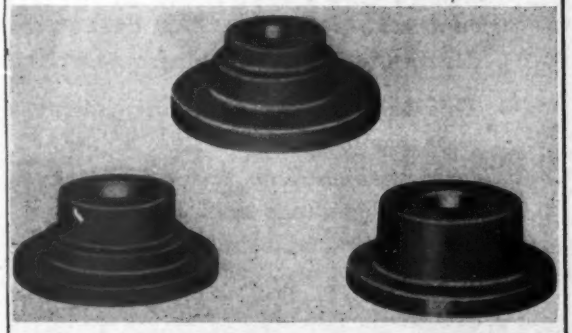
NITRATE OF POTASH
CAUSTIC SODA
SULPHUR

Stauffer

STAUFFER CHEMICAL CO.

420 Lexington Avenue, New York, N. Y. 624 California Street, San Francisco, Cal.
Chicago, Illinois 550 South Flower Street, Los Angeles, Cal.

Gunite's Standard grade A for Guide Rings



Like all Gunite glasshouse castings Standard grade A is used for guide rings because it is best adapted to this particular purpose.

There is a suitable Gunite Alloy for every type of glass mould part requirement. Miller plungers and guide rings, neck ring sticks, brushing stock, press and blow moulds.

Write us for details

GUNITE FOUNDRIES CORPORATION
ROCKFORD ILLINOIS

Index of THE GLASS INDUSTRY for 1944

A

A, B, C of Quality Control Part I, *Aug. p.* 358, Part II, *Sept. p.* 407
Absenteeism and Turnover, Reducing *Feb. p.* 66
Air Leakage and Waste, Compressed *Feb. p.* 67
American Ceramic Society
  Spring Meeting *Mar. p.* 114, *Apr. p.* 164
  Glass Division Papers *May p.* 211
  Glass Division Fall Meeting Papers *Oct. p.* 447
Analysis, Microanalytical Methods *Jan. p.* 21
Analytical Control Methods, Determination of the Precision of *Apr. p.* 163
Apparatus (Precision) for Rapid Determination of Indices of Refraction and Dispersion by Immersion *Mar. p.* 110

B

Batch Mixing and Feeding *Dec. p.* 545

C

Calculator for Computing Spectral Transmission of Glasses *June p.* 259
Care and Repair of Compressed Air Equipment Part I, *June p.* 260, Part II, *July p.* 310, Part III, *Aug. p.* 361
Ceramic Color Decoration and Post War Markets *Aug. p.* 351
Colored Glasses Part I, *June p.* 262, Part II, *Sept. p.* 405
Compressed Air
  Air Leakage and Waste *Feb. p.* 67
  Care and Repair of Equipment Part I, *June p.* 260, Part II, *July p.* 310, Part III, *Aug. p.* 361
Crystal Chemistry, Glass Research Turns to *Sept. p.* 409
Current Statistical Position of Glass *Jan. p.* 29, *Feb. p.* 74, *Mar. p.* 122, *Apr. p.* 171, *May p.* 233, *June p.* 272, *July p.* 319, *Aug. p.* 365, *Sept. p.* 413, *Oct. p.* 461, *Nov. p.* 509, *Dec. p.* 557

D

Decoration, Post War Markets for Ceramic Color *Aug. p.* 351
Definition of Glass (The Floor of Heaven) *Feb. p.* 61
Determination of the Precision of Analytical Control Methods *Apr. p.* 163

E

Editorials
  Distinction Not Definition *Jan. p.* 17
  The Value of Statistics *Mar. p.* 109
Electric Lamp Production, WPB Report *Nov. p.* 504
Electrical Conductivity of Glass *Sept. p.* 399
Elementary Principles of Controlling Quality of Product During Manufacturing *Oct. p.* 450

F

Feeding, Batch Mixing and *Dec. p.* 545
Fiber Glass, Significance of New Data on Combination with Plastic *June p.* 266
Floor of Heaven, The *Feb. p.* 61
Foreman's Part in Better Labor Relations *Apr. p.* 166
Forming Machines, Glass *Feb. p.* 63
Friggers, Glasshouse *Mar. p.* 113, *Apr. p.* 166, *June p.* 265, *July p.* 312, *Nov. p.* 503

G

Gayner Glass Works *Apr. p.* 159
Glass at Edgewood Arsenal *Aug. p.* 354
Glass, Colored Part I, *June p.* 262, Part II, *Sept. p.* 405
Glass Conference, The Eighth Urbana *Dec. p.* 543
Glass Container Association
  Summer Meeting *July p.* 305
  Fall Meeting *Oct. p.* 455
Glass Cutting, Mechanism of Part I, *Jan. p.* 23, Part II, *Feb. p.* 68
Glass Division
  Spring Meeting Paper Summaries *May p.* 211
  Fall Meeting Paper Summaries *Oct. p.* 447
Glasshouse Friggers *Mar. p.* 113, *Apr. p.* 166, *June p.* 265, *July p.* 312, *Nov. p.* 503
Glass, New Resists H. F. *Dec. p.* 548
Glass Research Turns to Crystal Chemistry *Sept. p.* 409
Glass Science, Inc. *Mar. p.* 115
Glass, Spectral Transmission Calculator *June p.* 259
Glass Theses at Alfred *Sept. p.* 399
Goggles, Safety (Pictorial) *Mar. p.* 116

H

H. F., New Glass Resists *Dec. p.* 548

I

Improvements in Tank Furnace Design *Dec. p.* 550

J

Johnny Bull (Forming Machine) *Feb. p.* 63

L

Labor
  Priority Referral Plan for Labor *July p.* 315
  Reducing Absenteeism and Turnover *Feb. p.* 66
  The Foreman's Part in Better Labor Relations *Apr. p.* 166
  What Glass Manufacturers Should Know About Veteran Rehiring *July p.* 313

M

Mechanism of Glass Cutting Part I, *Jan. p.* 23, Part II, *Feb. p.* 68
Meetings
  American Ceramic Society *Mar. p.* 114, *Apr. p.* 164, *May p.* 211
  Eighth Urbana Glass Conference *Dec. p.* 543
  Glass Container Association *July p.* 305, *Oct. p.* 455
  Glass Division Spring Meeting *May p.* 211
  Glass Division Fall Meeting *Oct. p.* 447
  Optical Society *Nov. p.* 501
Microanalytical Methods for the Investigation of Glass Part II, *Jan. p.* 21
Mixing and Feeding, Batch *Dec. p.* 545
Monopoly Suit
  Supreme Court, Hartford Empire, Hazel-Atlas Patent Suit Opinion *June p.* 264
  Supreme Court Hears Glass Defendants' Case Against Toledo Decree *Nov. p.* 495

O

Optical Society Meeting *Nov. p.* 501
Owens-Illinois, Texas Plant *May p.* 218

P

Patents
  Annealing and Tempering *Jan. p.* 34, *Feb. p.* 72
  Compositions *Jan. p.* 26, *Feb. p.* 71, *Mar. p.* 117, *May p.* 220, *Aug. p.* 362, *Sept. p.* 410, *Oct. p.* 458, *Nov. p.* 505, *Dec. p.* 554
  Feeding, Forming and Shaping *Jan. p.* 27, *Feb. p.* 71, *Mar. p.* 117, *Apr. p.* 168, *May p.* 220, *June p.* 268, *July p.* 316, *Aug. p.* 362, *Sept. p.* 411, *Oct. p.* 458, *Nov. p.* 505, *Dec. p.* 554
  Furnaces *Feb. p.* 71, *Sept. p.* 410, *Nov. p.* 505
  Glass Wool and Fiber *Jan. p.* 34, *Mar. p.* 119, *Apr. p.* 186, *May p.* 236, *July p.* 317, *Aug. p.* 374, *Sept. p.* 411, *Oct. p.* 468, *Nov. p.* 523, *Dec. p.* 568
  Miscellaneous Processes *Jan. pp.* 26, 34, *Feb. p.* 72, *Mar. p.* 117, *Apr. p.* 168, *May p.* 221, *June p.* 269, *July p.* 316, *Aug. p.* 362, *Sept. p.* 411, *Oct. p.* 458,

Nov. p. 506, *Dec.* p. 555
Sheet and Plate Glass *Jan.* p. 34, *Feb.* p. 72, *Mar.* p. 118, *Apr.* p. 169, *May* p. 220, *June* p. 270, *July* p. 317, *Aug.* p. 374, *Sept.* p. 411, *Oct.* p. 459, *Nov.* p. 507, *Dec.* p. 556

Plant Layout
Gayner Glass Works *Apr.* p. 159
Owens-Illinois, Texas Plant *May* p. 218

Preston Laboratories, Research at *Jan.* p. 18
Priority Referral Plan for Labor *July* p. 315
Pyrex Brand Chemical Glass as a Bond in Porcelain *Sept.* p. 399

Q

Quality Control
A, B, C of Quality Control Part I, *Aug.* p. 358, Part II, *Sept.* p. 407
Controlling Quality of Product During Manufacturing *Oct.* p. 450
Determination of the Precision of Analytical Control Methods *Apr.* p. 163

R

Recent Developments in Wage and Salary Stabilization *Sept.* p. 402
Refractive Index and Dispersion, Apparatus for the Rapid Determination of *Mar.* p. 110
Refractories, Shape of Corrosion Produced by Molten Glass *Sept.* p. 404
Research in Glass at Preston Laboratories *Jan.* p. 18
Research Digest
Chemical Analysis, *Sept.* p. 412, *Dec.* p. 556
Chemical Resistance *Aug.* p. 364
Defects *May* p. 222, *Aug.* p. 364, *Sept.* p, 412
Fuels, Furnaces and Pyrometry *Mar.* p. 120, *July* p. 328, *Nov.* p. 508
Glass Making Materials *Apr.* p. 170, *May* p. 222
Glass, Uses of *Jan.* p. 28, *Feb.* p. 70, *Mar.* p. 120
Physical Properties *Feb.* p. 70, *June* p. 271, *Aug.* p. 364, *Sept.* p. 412, *Oct.* p. 460
Physical Testing *Jan.* p. 28, *Apr.* p. 170, *June* p. 271
Quality Control *Oct.* p. 460
Refractories *Jan.* p. 28, *Dec.* p. 556

S

Shape of Refractory Corrosion Produced by Molten Glass *Sept.* p. 404
Significance of New Data on Combinations of Plastic and Glass Fibers *June* p. 266
Statistics, Current *Jan.* p. 29, *Feb.* p. 74, *Mar.* p. 122, *Apr.* p. 171, *May* p. 223, *June* p. 272, *July* p. 319, *Aug.* p. 365, *Sept.* p. 413, *Oct.* p. 461, *Nov.* p. 509
Supreme Court, Hartford Empire, Hazel-Atlas Patent Suit Opinion *June* p. 264
Supreme Court Hears Glass Defendants' Case Against Toledo Decree *Nov.* p. 495
Swedish Glass Under War Conditions *Nov.* p. 498

T

Tank Furnace Design, Improvements in *Dec.* p. 550

V

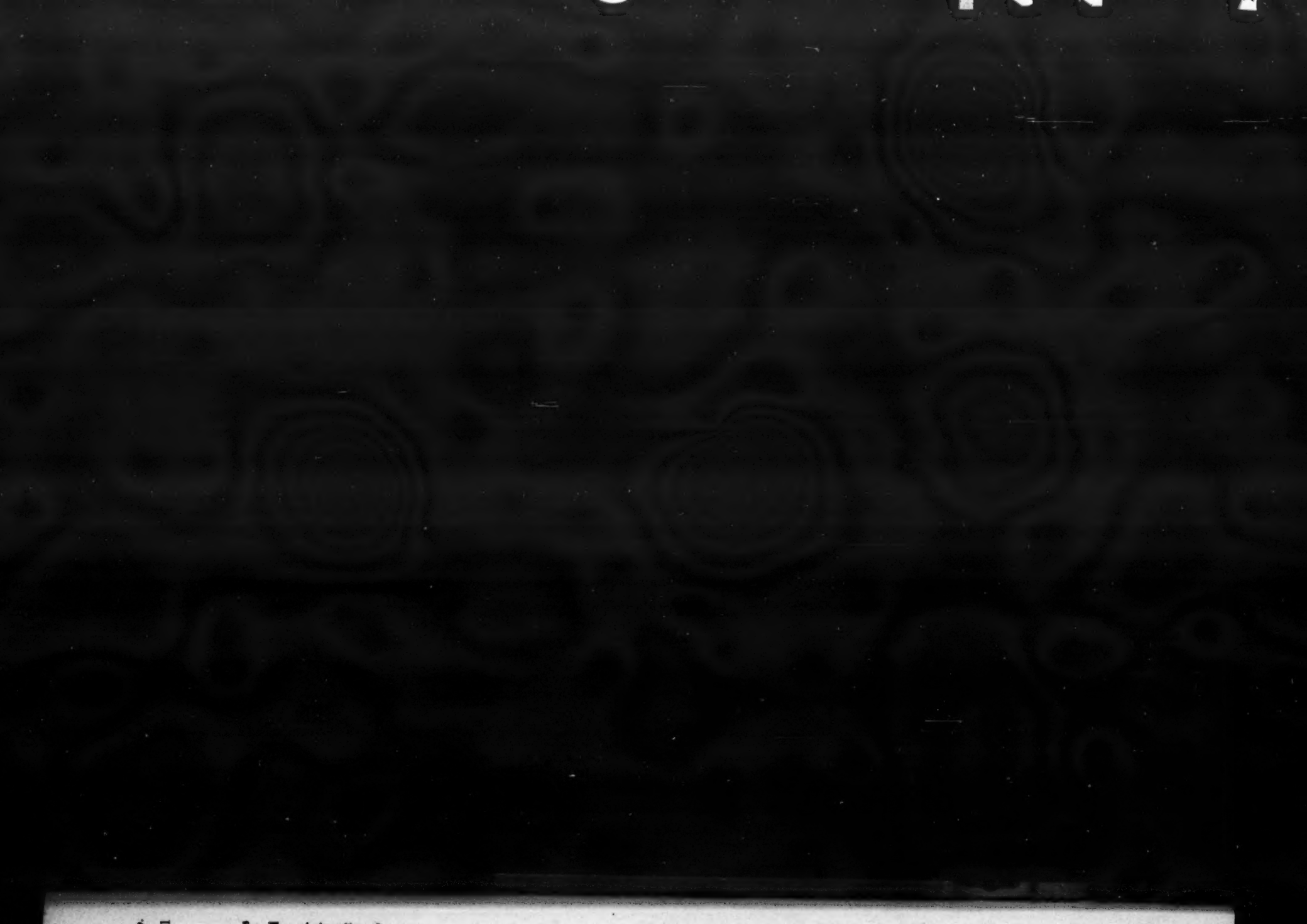
Veteran Rehiring *July* p. 313

W

Wage and Salary Stabilization, Recent Developments *Sept.* p. 402
W. P. B. Report on Electric Lamp Production *Nov.* p. 504

BOUND VOLUMES FOR 1944

• By placing your order now a bound volume of THE GLASS INDUSTRY for 1944 will be reserved for you. Restrictions on the use of paper necessarily limit the available supply, therefore, copies must be reserved as orders are received. All twelve issues are attractively bound and with the annual index serve as an indispensable reference medium to all technical and production problems of glass manufacture. Price $7.50.

THE GLASS INDUSTRY

55 West 42nd Street **New York 18, N. Y.**